QE
262
A5
J93
1908

Cornell University Library

BOUGHT WITH THE INCOME
FROM THE
SAGE ENDOWMENT FUND
THE GIFT OF
Henry W. Sage
1891

A.300712 9/VIII/15

3777

The date shows when this volume was taken.

HOME USE RULES

All Books Subject to Recall

The Agricultural Library has on its shelves books of reference only, which are in daily use and cannot be loaned to students for longer periods than over night and over Sunday. Borrowers may take them out during the last hour before closing and return them during the first two hours of the next library day.

Books in bad condition or of great value will not be issued to borrowers.

Borrowers are responsible for all losses and damages.

Members of the instructing staff and graduate students who are entitled to draw books for longer periods for instruction and research work, cannot retain them for more than one month without permission of the Library Committee.

Readers are requested to report all cases of books marked or mutilated.

Do not deface books by marks and writing.

Cornell University Library
QE 262.A5J93 1908
The geology of the country around Andove
3 1924 004 542 035
engr

MEMOIRS OF THE GEOLOGICAL SURVEY.

ENGLAND AND WALES.

EXPLANATION OF SHEET 283.

THE GEOLOGY
OF THE COUNTRY AROUND
ANDOVER.

BY

A. J. JUKES-BROWNE, B.A., F.G.S.

PARTLY FROM NOTES BY F. J. BENNETT, F.G.S., AND
H. J. OSBORNE WHITE, F.G.S.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By WYMAN & SONS, Limited, Fetter Lane, E.C.

And to be purchased from
E. STANFORD, 12, 13, and 14, Long Acre, London;
W. & A. K. JOHNSTON, Ltd., 2, St. Andrew Square, Edinburgh;
HODGES, FIGGIS & Co., Grafton Street, Dublin;
From any Agent for the sale of Ordnance Survey Maps; or through any
Bookseller from the Ordnance Survey Office, Southampton.

1908.

Price One Shilling and Sixpence.

LIST OF MAPS, SECTIONS, AND MEMOIRS OF THE GEOLOGICAL SURVEY OF ENGLAND AND WALES, AND MUSEUM OF PRACTICAL GEOLOGY.

J. J. H. TEALL, M.A., D.Sc., F.R.S., Director of the Geological Survey and Museum, Jermyn Street, London, S.W.

The Maps and Memoirs are now issued by the Ordnance Survey. They can be obtained from Agents or direct from the Ordnance Survey Office, Southampton. Museum Catalogues, Guides, &c., are sold at the Museum, 28, Jermyn Street, London.

A Complete List of the Publications can be obtained from the Ordnance Survey Office, Southampton. Price 6*d.*

INDEX MAP (25 miles to the inch).

Map of the British Islands. Price—Coloured, 2*s.*; Uncoloured, 1*s.*

GENERAL MAP (one inch to 4 miles).

ENGLAND AND WALES.—Sheet 1 (Title); 2 (Northumberland, &c.); 3 (Index of Colours); 4 (I. of Man); 5 (Lake District); 6 (E. Yorkshire); 7 (North Wales); 8 (Central England); 9 (Eastern Counties); 10 (South Wales and N. Devon); 11 (W. of England and S.E. Wales); 12 (London Basin and Weald); 13 (Cornwall, &c.); 14 (South Coast Torquay to I. of Wight); 15 (S. Coast, Havant to Hastings). Sheet 1, 2*s.*; sheets 2 to 15, 2*s.* 6*d.* each. *Printed in colours.*

NEW SERIES.—Drift, Sheet 8 (Flamborough and Grimsby), 2*s.*; Sheet 12 (Peterborough, Norwich), 2*s.* 6*d.*

MAPS (one-inch). Old Series.

NOS. 1 to 110 in whole sheets and quarter-sheets, hand-coloured, in two editions, Solid and Drift—except 92 NE., SE., 93 NW., SW. 97 SE., 98 NW., SW., S.E., 101 S.E., which are published Solid only Prices, whole sheets, 4*s.* to 8*s.* 6*d.*; quarter-sheets, 1*s.* 6*d.* to 3*s.* Sheet 7, Drift, 18*s.* 6*d.*

MAPS (one-inch). New Series.

1 to 73. These New Series maps are identical with the Quarter Sheets of the Old Series, Nos. 91 to 110, all of which are published with Drift, excepting Sheets 29, 38, 48, 49, 51, 61, 62, 69, and 76.

		Price. Solid. *s. d.*	Price. Drift. *s. d.*
	LONDON in four Sheets (Colour printed) each	—	1 6
	ISLE OF MAN Sheets 36, 45, 46, 56, and 57	8 6	8 6
54.	SCARBOROUGH (Colour printed) ..	3 6	1 6
110.	MACCLESFIELD (Colour printed) ..	—	1 6
123.	STOKE-UPON-TRENT (Colour printed)	1 6	1 6
125.	DERBY AND WIRKSWORTH (Colour printed)	—	1 6
141.	LOUGHBOROUGH (Colour printed)	—	1 6
155.	ATHERSTONE	3 6	3 6
156.	LEICESTER (Drift; Colour printed)	3 0	1 6
187.	HUNTINGDON	—	3 6
203.	BEDFORD	—	3 0
230.	AMMANFORD (Colour printed) ..	1 6	1 6
231.	MERTHYR TYDFIL (Colour printed)	1 6	1 6
232.	ABERGAVENNY (Colour printed) ..	1 6	1 6
246.	WORMS HEAD (Colour printed) ..	1 6	1 6
247.	SWANSEA (Colour printed)	1 6	1 6
248.	PONTYPRIDD (Colour printed) ..	1 6	1 6
249.	NEWPORT (MON.), (Colour printed)	1 6	1 6
254.	HENLEY-ON-THAMES (Colour printed)	—	1 6
261–2.	BRIDGEND (Colour printed) ..	1 6	1 6
263.	CARDIFF and WORLE, SOMERSET (Colour printed)	1 6	1 6
267.	NEWBURY (Colour printed)	—	1 6
268.	READING (Colour printed)	—	1 6
282.	DEVIZES (Colour printed)	—	1 6
283.	ANDOVER (Colour printed)	—	1 6
284.	BASINGSTOKE (Colour printed) ..	—	1 6
295.	TAUNTON AND BRIDGWATER (Colour printed)	—	1 6
298.	SALISBURY (Colour printed) ..	—	1 6
299.	WINCHESTER (Colour printed) ..	—	1 6
300.	NEW ALRESFORD (Colour printed)	—	1 6
311.	WELLINGTON and CHARD (Colour printed)	—	1 6

		Price. Solid. *s. d.*	Price. Drift. *s. d.*
314.	RINGWOOD (Colour printed) ..	—	1 6
315.	SOUTHAMPTON (Colour printed) ..	—	1 6
316.	HAVANT	—	1 6
317.	CHICHESTER	—	1 6
325.	EXETER	—	3 0
326 and 340.	SIDMOUTH AND LYME REGIS (Colour printed)	—	1 6
328.	DORCHESTER (Colour printed) ..	—	1 6
329.	BOURNEMOUTH, WIMBORNE, (Drift, Colour printed)	3 6	1 6
330.	Parts of NEW FOREST and part of ISLE OF WIGHT (Drift, Colour printed)	3 0	1 6
331.	PORTSMOUTH and part of ISLE OF WIGHT (Drift, Colour printed) ..	3 0	1 6
	ISLE OF WIGHT in one Sheet (Colour printed)	—	2 6
332.	BOGNOR, &c. (Colour printed) ..	1 6	1 6
333.	WORTHING, ROTTINGDEAN ..	—	1 6
334.	NEWHAVEN, EASTBOURNE (Colour printed)	—	1 6
339.	NEWTON ABBOT	—	3 6
341.	WEST FLEET (Colour printed) ..	.	1 6
342.	PORTLAND, WEYMOUTH, LULWORTH (Colour printed)	—	1 6
343.	SWANAGE, CORFE CASTLE	—	1 6
346.	NEWQUAY (Colour printed)	—	1 6
348	PLYMOUTH AND LISKEARD (Colour printed)	—	1 6
349.	PLYMOUTH and IVYBRIDGE ..	—	3 0
350.	TORQUAY	—	3 0
351 & 358.	LAND'S END DISTRICT ..	—	2 6
352.	FALMOUTH and TRURO (Colour printed)	—	1 6
353.	MEVAGISSEY (Colour printed) ..	—	1 6
355.	KINGSBRIDGE	—	3 0
356.	START POINT	—	1 6
357 & 360.	ISLES OF SCILLY (Colour printed)	—	1 6
—	OXFORD SHEET (Special)	—	1 6

MAPS (six-inch).

The Coalfields and other mineral districts of the N. of England (the N. Staffordshire and S. Wales) Coalfields, and Leicestershire and Derbyshire, are in part published on a scale of six inches to a mile. MS. Coloured Copies of other six-inch maps, not intended for publication, are deposited for reference in the Geological Survey Office, Jermyn Street, London, and copies can be supplied at the cost of drawing and colouring the same.

HORIZONTAL SECTIONS.

1 to 140, 146 to 148, price 5*s.* each

VERTICAL SECTIONS.

1 to 86, price 3*s.* 6*d.* each.

MEMOIRS OF THE GEOLOGICAL SURVEY.
ENGLAND AND WALES.
EXPLANATION OF SHEET 283.

THE GEOLOGY
OF THE COUNTRY AROUND
ANDOVER.

BY

A. J. JUKES-BROWNE, B.A., F.G.S.

PARTLY FROM NOTES BY F. J. BENNETT, F.G.S., AND
H. J. OSBORNE WHITE, F.G.S.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By WYMAN & SONS, Limited, Fetter Lane, E.C.

And to be purchased from
E. STANFORD, 12, 13, and 14, Long Acre, London;
W. & A. K. JOHNSTON, Ltd., 2, St. Andrew Square, Edinburgh;
HODGES, FIGGIS & Co., Grafton Street, Dublin;
From any Agent for the sale of Ordnance Survey Maps; or through any
Bookseller from the Ordnance Survey Office, Southampton.

1908.

Price One Shilling and Sixpence.

Cornell University Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

http://www.archive.org/details/cu31924004542035

PREFACE.

THE area described in this Memoir was originally surveyed on the old series one-inch map Sheets 12 and 14 by W. T. Aveline, H. W. Bristow and R. Trench, and the geological information was published in 1857 and 1860. It was re-surveyed on the six-inch scale by Mr. F. J. Bennett, who was responsible for the main portion of the work, and by Mr. C. E. Hawkins, who surveyed the southern borders.

The geology of the country was to some extent described in the Memoir on "The Geology of parts of Berkshire and Hampshire," by H. W. Bristow and William Whitaker, 1862, but little was then known about the divisions of the Cretaceous rocks. Many years later the various quarries in the Chalk were explored for fossils by Mr. C. Griffiths, of Winchester, and Mr. R. M. Brydone.

Mr. Jukes-Browne has written this new Memoir, with the help of notes made by Mr. Bennett during the course of his field-work, and with further special assistance from Mr. H. J. Osborne White.

We are specially indebted to Mr. Griffiths and Mr. Brydone for placing at our disposal all the information which they have gained respecting the zonal divisions of the Chalk, and the fossils found in them.

The lists of fossils have been revised in the Palæontological Department by Mr. H. A. Allen.

J. J. H. TEALL,
Director.

Geological Survey Office,
28, *Jermyn Street, London,*
23RD JUNE, 1908.

9254. 500—Wt. 5004. 9/08. Wy & S. 4881*r*.

CONTENTS.

PAGE.

Preface by the Director - - - - - iii

Chapter I.—Introduction. Area; Physical Features; Watersheds and River Valleys. Formations. Tectonic Structure. Relation between Structure and Valleys. Previous Literature - 1

Chapter II.—Upper Greensand. General Description. Local Notes 9

Chapter III.—Lower and Middle Chalk—

Lower Chalk: General Description. Local Notes 13

Middle Chalk: General Description. Local Notes - 17

Chapter IV.—Upper Chalk. General Description. Zones of *Holaster planus* and *Micraster cortestudinarium*. Zone of *Micraster coranguinum*. Zones of *Marsupites* and of *Actinocamax quadratus* 22

Chapter V.—Eocene. 1. Reading Beds; 2. London Clay; 3. Bagshot Beds; 4. Bracklesham Beds; 5. Upper Sands - 39

Chapter VI.—Clay-with-Flints.—Disposition and Origin. Notes of local exposures 50

Chapter VII.—Superficial Gravels and Alluvium. Plateau Gravel. Valley Gravels. Alluvium - 55

Chapter VIII.—Miscellaneous. Springs, Bournes, and Soils 58

Appendix.—Wells and Borings 61

Index - 64

ILLUSTRATIONS.

PAGE.

Fig. 1. Section from Wexcombe in the Vale of Pewsey to near Rivar in the Vale of Shalbourn - - 4

" 2. Section from Linkenholt to East Woodhay 4

" 3. Sections through the railway-cuttings north of Grafton 10

" 4. Section along the railway-siding to Dods Down 19

" 5. Section from Clatford Down to the Bourn Valley at Stoke 23

" 6. Section from Stoke Hill to Burghclere, across the Kingsclere anticline 23

" 7. Section through the Upper Chalk in the railway-cutting north of Burghclere - - 30

" 8. Diagram of the beds seen in the Hollington Brickyard 44

" 9. Section along the railway near Highclere - - 47

" 10. Section in the railway-cutting south of Highclere Station - 48

" 11. View of clay pit in Harewood Forest - - - 53

" 12. View in gravel pit at Whitchurch - - - - 56

LIST OF SIX-INCH MAPS INCLUDED IN ONE-INCH SHEET 283.

Wiltshire,	36.	(S.E. only) Burbage	by F. J. Bennett.
„	37.	(South edge only) Kinwardstone	by F. J. Bennett.
„	42.	East Grafton, Collingbourne Kingston	by F. J. Bennett.
„	43.	Wexcombe, Linkenholt, and Vernhams Dean	by F. J. Bennett.
Hampshire,	2.	Woodhay	by F. J. Bennett.
„	3.	Aldbury Park and Headley	by F. J. Bennett.
„	8.	Faccombe and Ashmansworth	by F. J. Bennett and C. E. Hawkins.
„	9.	Burghclere, Kingsclere, and Hannington	by F. J. Bennett and C. E. Hawkins.
„	16.	Hurstbourne and St. Mary Bourne	by F. J. Bennett.
„	17.	North Oakley, Overton and Ashe	by F. J. Bennett and C. E. Hawkins.
„	24.	Whitchurch	by F. J. Bennett and C. E. Hawkins.
„	25.	Steventon	by C. E. Hawkins.

THE GEOLOGY

OF THE COUNTRY AROUND

ANDOVER.

CHAPTER I.

INTRODUCTION.

Area.—Sheet 283 of the Ordnance and Geological Survey map represents an area of 216 square miles, lying mainly within the county of Hampshire but including about 42 square miles of the eastern part of Wiltshire. The chief town within this area is Andover, which is situate about two miles from the southern margin of the map. To the east and north-east are Whitchurch Overton and Kingsclere; on the western border are the Collingbournes, with East and West Grafton in the north-west corner.

Physical Features.—The greater part of the district consists of Chalk uplands, which may be described as an eastern extension of Salisbury Plain, but they differ from those north of Salisbury in being much more wooded, for at least three large woods still remain as relics of the former widespread forests; these are Collingbourne Wood, Doles Wood and Harewood Forest near Andover.

The district includes the extreme eastern end of the Vale of Pewsey, the southern part of the Vale of Shalbourn and nearly the whole of the Vale of Kingsclere. These " vales " are bordered though not entirely surrounded by steep escarpments of Chalk, which rise into greater elevations than any of the hills in the southern part of the area. Thus the downs south of Wexcombe and Tidcombe rise to over 800 feet, the highest point being 876 feet above the sea; another tract between Buttermere and Combe rises to over 800 feet, and north of Combe is Walbury

Camp the summit of which is 975 feet. Near Burghclere, Sidown Hill and Beacon Hill are over 800 feet high, and the hills south of Sydmonton are over 700 feet.

From this range of heights the country has a general slope toward the south, that is to say, the summit-levels of the hills and ridges decline in elevation as they pass in that direction, so that in the southern part of the district very little ground rises to more than 400 feet except near the south-western border, where a long ridge, running north and south from Shaw Hill to Cholderton Hill, has an elevation of more than 500 feet, its highest point near Tidworth being 575 feet.

Watersheds and River Valleys.—A peculiarity of this district is that the main watershed does not everywhere coincide with the line of highest ground. This watershed enters the area near the north-west corner within the Vale of Pewsey at an elevation of only 528 feet; thence it passes to higher levels in a south-east direction over Wexcombe and Tidcombe Downs, but then turns northward and sinks to 600 feet east of Tidcombe. From this point it circles around the northern border of the area at high elevations as far as Sidown Hill, near Highclere; thence it sinks into the Vale of Kingsclere, where the levels are only between 400 and 500 feet; passing obliquely across this plain it again ascends to high ground on the southern side of it and leaves the eastern border of the area at an elevation of 700 feet. The reason of this anomalous course will be explained presently.

The principal river of the district is the Test, which rises between Overton and Ashe just outside the eastern border of the sheet. Its valley crosses the south-eastern part of the area and its chief tributaries come from the north-west; these are the Bourne and the Anton, which drain all the central part of the district. On the western border is the upper course of another Bourne which runs into the Avon.

Into these main valleys open a number of smaller valleys and combes, which are not occupied by permanent brooks but are only watercourses after heavy rains.

Formations.—The deposits of different age which enter into the structure of the country and are distinguished by different colours on the colour-printed issue of the map are the following :—

		Thickness in Feet.
Post Tertiary.	Alluvium.	
	Valley Gravel.	
Of Uncertain Age.	Plateau Gravel.	
	Clay with Flints	
Eocene.	Upper (Bagshot) Sands*	about 30
	Bracklesham Beds	,, 40
	Lower (Bagshot) Sands	,, 70
	London Clay	,, 100
	Reading Beds	,, 60
Cretaceous.	Upper Chalk - -	,, ? 450
	Middle Chalk	,, ? 120
	Lower Chalk - -	,, 200
	Upper Greensand (Selbornian)	,, 150

---

* These sands are probably part of the Bracklesham group.

On the first edition of the map the whole of the Chalk was coloured with the same tint, the boundaries of the Middle and Upper Chalk being indicated by lines bordered with dark green: but on the later colour-printed edition the three stages of the Chalk are indicated by distinct tints of green.

By far the larger portion of the area (eleven-twelfths of it) is occupied by the several divisions of the Chalk, covered here and there by patches of Clay-with-flints and by strips of Valley-gravel. The Selbornian sands do not occupy more than 6 or 7 square miles of ground and the Tertiary strata occur only in the north-eastern corner and do not cover more than 12 square miles.

Tectonic Structure.—The appearance of the Selbornian Greensand in the Vales of Pewsey, Shalbourn and Kingsclere is due to the existence of an anticlinal flexure which runs from west to east and is continued through the Wealden area south of the Hogsback ridge in Surrey.

If the curvature of this anticline had been equally great throughout its course there would have been a continuous outcrop of the Selbornian sands through the northern part of the area uniting the Vale of Pewsey to that of Kingsclere. The pitch of the anticlinal arch is, however, much lower in some places than in others, and the Greensand is only exposed in those parts where the curvature is greatest and where the beds have been bulged upward into elliptical domes.

It should also be observed that the line of flexure is by no means straight; from the western end of the Vale of Kingsclere it curves to the north-west and a second elongate swelling of the anticline brings up the Lower Chalk near East Woodhay. The axis then curves westward again, and passing just to the north of our area bulges into a third elliptical dome in the Vale of Shalbourn, where the Selbornian is again exposed. Thence it passes to the Vale of Pewsey which is separated from that of Shalbourn by a bridge of chalk filling the synclinal depression between the two periclines (*see* Fig. 1).

It must be remembered that this bridge of chalk really rests on the summit of an anticline, and is only a syncline in relation to the periclinal protuberances on each side of it. A section drawn at right angles to the above, *i.e.*, from N.W. to S.E., would show an anticlinal curvature.

Another peculiarity of this irregular anticline is that the northern limb of the arch has everywhere a much steeper inclination than the southern limb; and it is this steep inclination to the north which brings in the Eocene near Kingsclere and Highclere and Woodhay. This peculiarity is shown in Fig. 2, as well as in the section which accompanies the colour-printed edition of the map. A section across the Vale of Pewsey shows precisely the same structure, as may be seen from that given in the Explanation of sheet 282 (the country around Devizes).

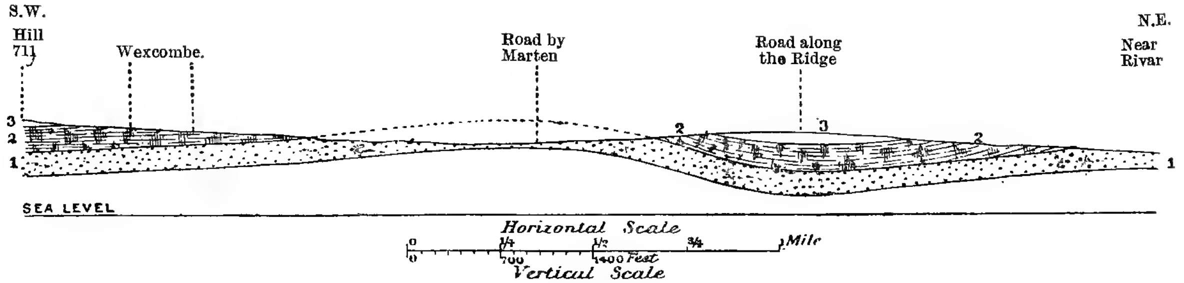


FIG 1. *Section from Wexcombe in the Vale of Pewsey to near Rivar in the Vale of Shalbourn.*
1. Upper Greensand. 2. Lower Chalk. 3. Middle Chalk.

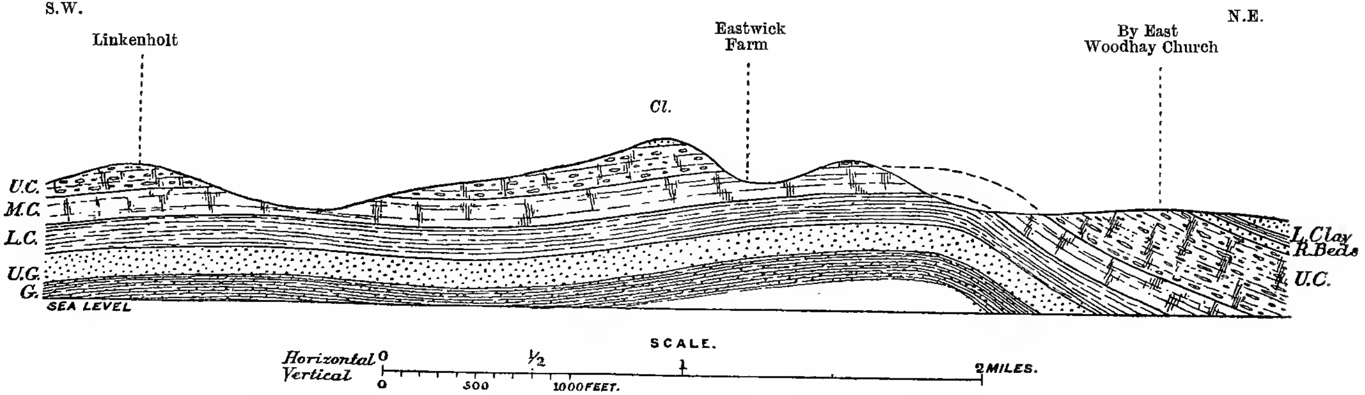


FIG 2. *Section from Linkenholt to East Woodhay.*
Cl. Clay-with-flints.
U.C. Upper Chalk.
M.C. Middle Chalk.
L.C. Lower Chalk.
U.G. Upper Greensand. } Selbornian.
G. Gault. } Selbornian.

It will be seen from the map and from the section engraved on the sheet that from the high level of the northern anticline the beds sink gradually southwards. Thus the base of the Upper Chalk, which near Walbury Hill is at a level of 700 feet, sinks southwards to 400 feet at Hurstbourne Tarrant, and to a little over 300 feet at Stoke in the same valley. The southern half of the area in Sheet 283 is probably part of a broad synclinal flexure corresponding to the northern anticline, and in this syncline the base of the Upper Chalk must sink down to the level of the sea, for near Andover a large part of the Upper Chalk is known to come in, probably amounting to a thickness of about 400 feet below Harewood Forest, where the surface of the ground is between 300 and 400 feet above the sea-level. (*See* Fig. 9.)

Relation between Structure and Valleys.—It has already been stated that the main watershed of the district runs through the Vales of Pewsey and Kingsclere, instead of keeping entirely to the highest ground. As a consequence of this the valley-heads of certain streams lie within the limits of these Vales; thus the western Bourne has its source within the Vale of Pewsey, and cuts directly through the southern side of this vale at Kingston Collingbourne. In the same way the southern side of the Vale of Kingsclere is breached by a valley to the south of Burghclere, and though little water now flows through this gap, it is continued southward through Litchfield and opens into the valley of the Test to the east of Whitchurch.

The northern side of the Kingsclere inlier is also breached in three places by little brooks rising within it, just as both borders of the Wealden area are traversed by rivers flowing outward from the central axis. The explanation of all these facts is to be found in the geological structure, and in the detritive processes which have developed a "vale" or depression out of the tectonic dome. When the valley-system was first established these periclinal axes were not "vales," but more or less rounded ridges or "hog-backs," and included the most elevated portions of the surface which naturally formed parts of the original watershed. Rain falling on these ridges established watercourses on their outer slopes, and the watercourses formed valleys which have maintained their relative positions during the general detrition of the country, and always carried off the drainage northward and southward from the line of watershed, even when this had sunk below the level of the growing escarpments of the Chalk.

It has been pointed out that this line of watershed no longer corresponds exactly with the line of the anticlinal axis, but has undergone considerable modification during the processes of valley erosion and the recession of spring-heads. In connection with this modification of the drainage, Mr. Osborne White has remarked that the eastern and western portions of the anticlinal flexure differ in this respect; that east of the village of Burbage in the Vale of Pewsey "the northward streams have had things much their own way; removing the crown of the arch, developing small longitudinal trenches along the axis of the fold, and pushing back the heads of the competing southern streams, now represented only by gaps in the southern Chalk-escarpment. But to the west the conditions were reversed and the southward flowing Salisbury Avon had gained the upper hand." *

It is also worthy of note that between the two main swellings of the anticlinal axis, those of Pewsey and Kingsclere, the escarpment ridge of the Chalk attains a greater height than it does anywhere on the southern lips of those swellings. Moreover in this part of the area this ridge forms a continuous watershed; consequently the sources of the eastern Bourne lie on the south side of the main escarpment, but owing to the great northerly bend in the anticlinal flexure the heads of its tributary valleys lie farther north than do those which rise in the vales of Pewsey and Kingsclere.

Previous Literature.—The geological literature dealing with this area is not very extensive, but several writers have described portions of it in greater or less detail, and the following are notices of the principal contributions to our knowledge of the strata and their mode of occurrence.

The first who paid special attention to the structure of the Kingsclere district was Professor Buckland, who wrote a memoir to which he gave the following title, "On the Formation of the Valley of Kingsclere and other Valleys by the Elevation of the Strata which Enclose them; and on the Evidences of the Original Continuity of the Basins of London and Hampshire." †

In this he describes the anticlinal structure of the vale and shows that the Eocene is involved in it. He also notes that the drainage of this and similar valleys is effected by apertures in one of their lateral escarpments, "and not at either extremity of their longer axis, as would have been the case had they been simply excavated by the sweeping force of rapid water." He proposes to call such excavated anticlines "Valleys of Elevation," but does not explain the manner in which the lateral valleys were made. It was not till 1865 that the origin of these were satisfactorily explained by Messrs. Foster and Topley. ‡

Nearly the whole of the area included in sheet 283 comes within the limits of sheet 12 of the old series of Ordnance maps and consequently within the scope of the Geological Survey memoir on that sheet published in 1862 and written by H. W. Bristow and W. Whitaker. § These authors give a general description of the Cretaceous strata, with some particulars of the inliers of Shalbourn and Kingsclere, and a more complete account of the Eocene Beds and the Superficial Deposits.

In his papers on "The Basement Bed of the London Clay," ||

---

* *Proc. Geol. Assoc.*, vol. xvii., p. 393 (1902).

† *Geol. Trans.*, vol. ii., 1826, pp. 119–130. pl. xvii. (map and section through Burghclere).

‡ See *Quart. Journ. Geol. Soc.*, vol. xxi., p. 460.

§ "The Geology of Parts of Berkshire and Hampshire," *Mem. Geol. Surv.*

|| *Quart. Journ. Geol. Soc.*, vol. vi., (1850), p. 252.

and "The Woolwich and Reading Series," * Professor Prestwich mentions sections in this area at Highclere, Ewhurst and Itchenswell.

Dr. J. Stevens published a history of St. Mary Bourne in 1863, which included a notice of the geology of the country round that place and a list of fossils collected from the junction of the Middle and Upper Chalk at Stoke by Mr. E. Westlake.

"The Geology of the Kingsclere Valley," was the subject of a lecture by Prof. T. R. Jones addressed to the Newbury Field Club during an excursion in September, 1871, and published in the *Geological Magazine.*† He described the structure of the Vale as an elliptical dome, two miles by six in its chief diameters, and referred to the "denudation," partly marine and partly subaerial, by which it has been reduced to its present condition.

Professor Ch. Barrois visited the Vale of Kingsclere and examined the Chalk country to the south of it along the valleys of the Bourne and the Test, his results being published in 1876.‡ He was the first to show that careful collection of fossils from our inland quarries would suffice to establish the existence of the zonal divisions which had been established by the study of cliff sections on both sides of the English Channel. He correctly identified the existence of the zones of *Holaster planus, Micraster cortestudinarium, Micraster coranguinum,* and *Marsupites,* and rightly inferred that in this region the Eocene Beds rest directly on his zone of *Marsupites,* a fact which is of much importance in considering the relations of the Eocene to the Chalk, because it proves the unconformity of the former to the latter. It must be remembered, however, that he did not clearly distinguish his zone of *Marsupites* from that of *Actinocamax quadratus.*

In 1888 the sections through the Eocene Beds on the Didcot and Winchester Railway near Highclere were described by the Rev. A Irving,§ partly from information obtained by Professor T. R. Jones in 1882 when the railway was being constructed. Mr. Irving was also the first to indicate (in this paper) the existence of a small outlier of Upper Bagshot Sand near Ridgemoor Farm in this district. He concludes with some remarks on the date of the Kingsclere anticline which he thinks was partly formed before the deposition of the Bagshot Sands.

Reference to the Kingsclere anticline, in connection with the physical features and river-valleys of the south-east of England, was made by Mr. A Strahan in 1896; || and later in more detail by Mr. Osborne White in 1902,¶ in a Report on an Excursion to Kintbury, Inkpen and Woodhay. Descriptions of the several divisions of the Upper Cretaceous Rocks were published in the

---

* *Ibid.* vol. x. (1854), p. 75.

† *Geol. Mag.*, vol. viii., p. 571.

‡ Recherches sur le Terr. Crét. Sup. de l'Angleterre, and *Mem. de la Soc. Geol. du Nord,* 1876, Lille, pp. 46–52.

§ *Quart. Journ. Geol. Soc.*, vol. xliv., p. 178.

|| *Proc. Geol. Assoc.*, vol. xiv., p. 405.

¶ *Ibid.*, vol. xvii., p. 391.

three successive volumes on those rocks prepared by me for the Geological Survey.* In the last of these (p. 183) reference was made to the excellent work done by Mr. Charles Griffiths, of Winchester, and Mr. R. M. Brydone in collecting fossils from all the exposures of chalk within this and the adjoining areas. It was entirely due to the labours of these two gentlemen, who generously placed the results at my disposal, that I was able to allocate these exposures to their zonal horizons with greater accuracy than Professor Barrois had been able to do in his rapid traverse of the country.

---

* Cretaceous Rocks of England. Vol. i. "Gault and Upper Greensand," 1901. Vol. ii. "The Lower and Middle Chalk," 1903. Vol. iii. "The Upper Chalk," 1904.

CHAPTER II.

UPPER GREENSAND.

SELBORNIAN.

The Upper Greensand is not a complete formation in itself, that is to say, it cannot rank as a separate subdivision of the Upper Cretaceous Series; for it and the underlying clay which is known as the Gault are largely replacive or complementary deposits. In Wiltshire the Gault clays represent only the Lower Gault of Kent, while in Hampshire there is also some Upper Gault Marl below the Upper Greensand, and as these marls thicken eastward through Surrey the Upper Greensand thins out. Thus the Gault and Upper Greensand together form a single formation or stage for which the term Selbornian has been recently proposed.

In the eastern part of the Vale of Pewsey the Selbornian Sands (or so-called Upper Greensand) are probably about 150 feet thick, and below the Vale of Kingsclere they may be 120 or 130 feet, but the lowest beds do not crop out to the surface anywhere within the area under description. They must, however, have been pierced by the deep well at Burghclere Manor House, which according to Mr. Broadhurst, of Penwood Farm, is 130 feet deep.

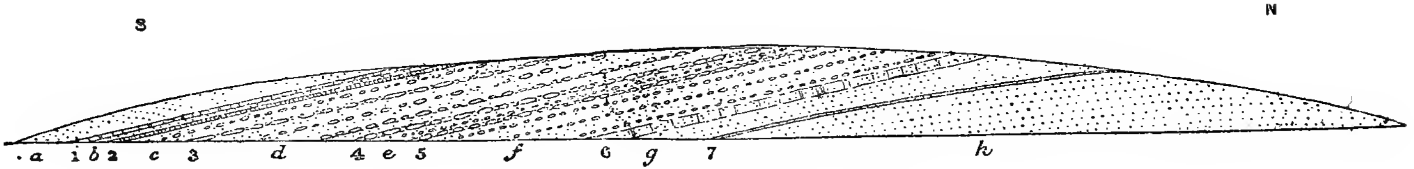
These lowest beds consist of fine-grained micaceous and siliceous stone which is known as *Malmstone.* These beds belong to the zone of *Schloenbachia rostrata* and pass up into soft micaceous sand which in turn passes into greyish-green sands consisting entirely of quartz and glauconite, generally in rather small and even sized grains. These sands are probably 100 feet thick, and they include layers and large lenticular concretions of calcareous sandstone.

The highest beds consist of green glauconitic sands containing nodules of flinty chert and dull cherty stone; these "chert beds" are probably from 20 to 25 feet thick, and are often separated from the sands below as the zone of *Pecten asper*, a fossil which generally occurs in them. The remains of siliceous sponges are also of common occurrence in these upper sands, and among other fossils the following may be mentioned—*Pecten robinaldinus* (d'Orb)*; Aucellina gryphæoides* (J. de C. Sow.), *Holaster lævis* Deluc, and *Discoidea subuculus* (Leske). In the sands below, *Schloenbachia rostrata* (J. Sow.) is sometimes found.

The following is probably the complete succession of the beds which form the Selbornian stage in this area:—

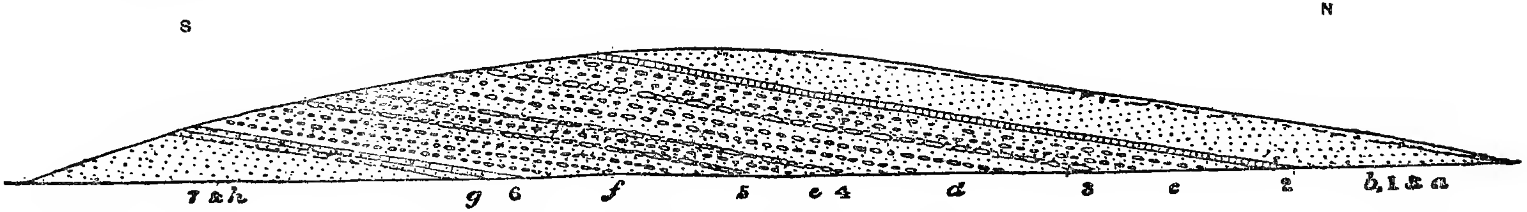
		Feet
Green sands with chert nodules - - - -		25- 20
Greenish grey sand - -		40- 30
Micaceous sand and sandstone - - -		60- 50
Malmstone and sandstone - -		30- 20
Sandy clay and marl	Gault - -	150-180
Dark grey clays - -		
		About 300

FIG. 3.—*Sections through the railway-cuttings north of Grafton, Wiltshire.* (F. J. BENNETT.)



A. View of the first or southern cutting.

a & *b*.	Greenish sand with small lumps of bluish-grey chert	5 feet
1.	Hard compact whitish sandstone	
2.	Layer of bluish-grey chert.	1 foot
c.	Green sand with sandstone doggers.	3 feet
3.	Doggers, hard and softer sandstone, cherty in places.	1 foot
d, 4, *e*.	Yellowish greensand, mottled in places, with occasional doggers.	8 feet
5.	Course of hard sandstone doggers.	1 foot
f.	Greensand, ferruginous and mottled.	2 feet
6.	Doggers of hard compact stone.	1 foot
g.	Dark greensand, mottled.	9 feet
7.	Soft mottled sandstone (hardened bed *h*).	2 feet
h.	Fine greenish grey sand.	4 feet



B. View of the second or northern cutting

Notes of Exposures.

In that part of the Vale of Pewsey which comes within the limits of Sheet 283 the best exposures are in the cuttings which were made in 1898 when the railway from Savernake was widened. These cuttings were examined by Mr. Bennett, who contributed the notes and sketches on which Fig. 3 was drawn. North of Grafton Station there are two cuttings, and as the beds exposed in them dip in opposite directions it is clear that in the space between them the railway passes over the summit of the anticlinal axis.

The first cutting north of Grafton shows a series of beds dipping southward, the highest of which cannot be many feet below the Chloritic Marl, At the southern end the dip is about 2½ degrees to the south, but this decreases northward, till at the northern end the beds are nearly horizontal. (*see* Fig. 3). In the second cutting the same beds are seen again, but here they are dipping to the north at about 3 degrees The thicknesses given are those noted in the first cutting.

From the lowest beds, *h*, *y* and *g*, *Schloenbachia rostrata*, *Aucellina gryphæoides* and *Pecten orbicularis* were obtained and these may certainly be regarded as belonging to the zone of *Schloenbachia rostrata*. Probably some of the yellowish-grey sands above also belong to this zone, but no fossils except *Serpula concava* (J. Sow.) were found in them. The beds a, b, c, with the interbedded sandstones yielded the following fossils, *Holaster lævis*, *Discoidea subuculus*, *Pecten asper* Lam., *P. orbicularis*, *P.* (*Neithea*) *quinquecostatus* J. Sow., *Aucellina gryphæoides*, *Hamites simplex* d'Orb.

Mr. Bennett also found some of the same beds exposed in the road cutting between Grafton and the railway station, and again south of the Church. At Marten in the cutting for the road near the School he saw " grey sand with thin beds of sandstone."

Although a portion of the Ham or Shalbourn inlier comes into the northern edge of the area by Rivar, no exposures were seen within its limits when the tract was surveyed by Mr. Bennett.

The larger inlier around Burghclere brings in a greater thickness of the formation, but, unfortunately, there do not seem to be many exposures, so that it was not possible to ascertain the succession of the beds which exist here. The following notes are taken from the memoir on the " Geology of Parts of Berkshire and Wiltshire " (1862) and are from the note-book of Mr. Aveline :—

" At Burghclere Farm [*i.e.*, by the Church] hard greensand was noticed, and also in the road cuttings further east. At the intersection of the four roads [? half a mile east of Sydmonton] dark greensand occurs, with ragstone above it, separating the former from other sands of a paler green colour and resembling malm."

" In the road to Itchenswell (north of Ham Farm and now spelled Ecchinswell) six feet of hard and white malm appear on the top, with nodular cherty concretions disseminated through it, and based on pale green, soft, malm-like sand ; the whole dipping nearly north at an angle of about 20 degrees. The beds are for the most part white with dark specks, imparting to the whole a dark grey appearance."

"Beds of hard compact sandstone may be seen in the turnpike road north-west of Burghclere Farm, and several beds of hard compact grey gritty sandstone on the road between Kingsclere and Burghclere."

The Greensand is traversed by two shallow cuttings on the railway near Burghclere. The cutting north of the station was visited by Mr. Rhodes in 1886, and he obtained the following fossils from beds of "greenish-grey sandstone."

Discoidea subuculus (*Leske*).
Holaster lævis (*Deluc*).
Serpula umbonata (*Mant.*)
Grammatodon carinatus (*J. Sow.*)
Exogyra sp.
Inoceramus sp.
Lima (Plagiostoma) globosa? *J. de C. Sow.*
Pecten (Æquipecten) asper *Lam.*
Pecten hispidus, *Goldf.*
Pecten (Syncyclonema) orbicularis *J. Sow.*
Pecten (Neithea) quinquecostatus *J. Sow.*
Nautilus elegans? *J. Sow.*

This assemblage suffices to show that the beds belong to the zone of *Pecten asper*, and consequently to the highest part of the Greensand. In the bank and drain by the side of the road at Burghclere Station-yard Mr. Rhodes found *Schloenbachia varians* (J. Sow.), *Calycoceras naviculare* (Mant.), a *Rhynchonella* and *Holaster lævis* in soft sand which must be near the top of the Selbornian and close to the base of the Lower Chalk.

CHAPTER III.

LOWER AND MIDDLE CHALK.

Until the year 1880 the Chalk was generally divided into three unequal portions, viz. (1) The Chalk Marl, (2) The Lower Chalk, (3) The Upper Chalk. In that year a better arrangement, based on the distribution of fossils, was proposed, and is now generally accepted.* By this arrangement three stages were established, for which the names Lower Chalk, Middle Chalk and Upper Chalk were adopted, and these three divisions or stages were found to correspond very closely with the stages which had been established by D'Orbigny in France—the Cenomanian, the Turonian, and the Senonian.

Each of these three stages throughout the south of England has a well-marked basement bed. Thus at the base of the Lower Chalk there is almost always a bed which contains glauconite grains and phosphatic nodules and is often called Chloritic Marl. At the base of the Middle Chalk there is the hard rocky bed to which the name of "Melbourn Rock" was given in 1880; and at the base of the Upper Chalk is the hard rock (also containing phosphatic nodules), to which Mr. Whitaker gave the name of "Chalk Rock" in 1859.

In this chapter both the Lower and Middle divisions will be dealt with, for neither of them occupies much space within the area of the map, since they are only exposed along the course of the northern anticline in those tracts from which the Upper Chalk has been removed.

LOWER CHALK.

The Lower Chalk has at its base a layer of glauconitic sandy chalk which is usually known as the "Chloritic Marl"; above this it includes the beds formerly known as the Chalk Marl and the Grey Chalk as well as a certain thickness of white chalk without flints which terminates in a band of soft grey shaly marl known as the "Belemnite Marl" from its frequently containing the belemnitoid fossil *Actinocamax plenus* (Blainv.).

The Lower Chalk is broadly divisible into two portions or zones, the lower part being characterised by the presence of *Schloenbachia varians* (J. Sow.), and *Mantelliceras mantelli* (J. Sow.), and the upper part by *Holaster subglobosus* (Leske), *Hol. trecensis* Leym., and to a less extent by *Haploceras austeni* (Sharpe), which is not common in Hampshire.

---

* See *Geol. Mag.*, Dec. 2, vol. vii. p. 248.

The Chloritic Marl often contains many fossils, these being for the most part similar to those found in the rest of the zone of *Schloenbachia varians*, but including a few which are specially characteristic of it such as the siliceous sponge *Stauronema carteri* Sollas. In the same way the marl with *Actinocamax plenus* may be regarded as a subzone of the *Holaster subglobosus* zone.

Besides the fossils above mentioned the following species are generally to be found in the Lower Chalk, *Metacanthoplites rotomagensis* (Brongn.), *Ptychodus decurrens* Ag. (palatal teeth), *Lima globosa* J. de C. Sow., *Lima aspera* (Mant.), *Rhynchonella mantelliana* (J. de C. Sow.), *Terebratula semiglobosa* J. Sow., and *Discoidea cylindrica* (Lam.).

With respect to thickness this stage must be more than 200 feet thick at the eastern end of the Vale of Pewsey, for its lower boundary near Wexcombe appears to coincide with the contour of 500 feet, while its upper boundary is mapped as near that of 700 feet, and there must be a dip to the south which may bring in twenty or thirty feet more than the actual difference in height. Moreover, on the hill south-west of Wexcombe, and about a third of a mile from the church, a well has been sunk through the chalk to a depth of 280 feet. Mr. W. Titt, of Warminster, informs us that a few feet of greensand were traversed at the bottom, and as about fifty feet may be allowed for Middle Chalk at the top, this would leave about 220 for the thickness of the Lower Chalk. As the thickness further west is at least 240 feet, and in Surrey to the east at least 200 feet, the above estimate seems very probable.

Of this thickness the zone of *Schloenbachia varians* probably occupies about two-thirds or 140 feet, leaving 80 feet as the depth of the *Hol. subglobosus* zone, but no definite bed has yet been recognised as marking the passage from one zone to the other in any part of Wiltshire, though a representative of the Totternhoe Stone does seem to exist in the inlier of Kingsclere.

The Lower Chalk comes up to the surface in four separate tracts within the area of Sheet 283, each such outcrop being due to a local bulging up or doming of the beds along the course of the great northern anticlinal axis. One of these tracts surrounds the eastern end of the Vale of Pewsey; the next encircles the inlier of Upper Greensand south of Shalbourn; the third is a small inlier of Lower Chalk near East Woodhay, the existence of which was unknown till the several stages of the Chalk came to be mapped; the fourth is of course the ring of Lower Chalk which surrounds the Greensand inlier near Kingsclere.

Notes of Exposures.

In the north-western outcrop the best exposures are in the cuttings on the line between Grafton and Collingbourne Kingston. Of these Mr. Bennett contributes the following notes. The first cutting about a mile south of Grafton Station shows about eight feet of firm flaggy grey chalk; the second shows at the northern end soft grey marly chalk with a curved (? conchoidal) structure, dipping southwards at 3 degrees, and passing beneath hard grey gritty chalk which lies in flaggy beds. The third cutting is about eight feet deep in the same hard gritty and flaggy chalk, while the fourth near Aughton shows nine feet of soft grey shaly chalk.

Early during this year (1906) a well was sunk by Mr. W. B. Gauntlett, of Collingbourn Kingston, on his farm about half a mile south-west of East Grafton. He informs me that the level of the ground at the spot is between 530 and 540 feet above O.D., that the depth of the well is 150 feet, passing through chalk for about 100 feet, then through a bed of mixed chalk and sand, below which was sand with layers of hard sandstone. These had to be blasted and water was found in soft dark-coloured earth at the bottom.

Mr. E. Meyrick, of Marlborough College, visited the site of this well in the summer and noticed that *Schloenbachia varians* was abundant in the chalk which had been thrown out.

In the road-cutting about two-thirds of a mile south-east of East Grafton some beds of hard siliceous chalk crop out and make ledges in the roadway, and just above these is a small pit in blocky-grey chalk.

At and near Wexcombe several exposures of Lower Chalk were noted by Mr. Bennett in 1890; the lowest is in the road-cutting a quarter-mile north of the church, between 500 and 550 feet, and shows tough flaggy grey chalk with curvilinear bedding. Higher up in the lane leading to Lower Farm there is hard siliceous chalk with blue-hearted cherty nodules. East of the church the road bank shows about six feet of tough greyish chalk weathering flaggy, and similar beds are seen again in the cutting further south just below the 600 feet contour-line. In the next cutting at about 650 feet there is rubbly grey chalk covered by a foot of hard nodular chalk like Melbourn Rock, but this may be a slipped mass.

The top of the Lower Chalk and its junction with the Melbourn Rock is exposed at the southern end of the cutting for the Dods Down Brick Company's railway siding. This exposure is close to the northern border of the map N.W. of Wilton; it was examined by Mr. Osborne White and described in another memoir,* but is here reprinted;—

	Ft.
Middle Chalk.—Melbourn Rock (see p. 19) - - - - -	6
Belemnite Marl.—Grey to greenish-grey shaly marl with a discontinuous layer of whiter blocky chalk (2 inches wide) near the middle, and many scattered angular and rounded pieces of the same. *Actinocamax plenus* (Blainv.) and *Cidaris hirudo* Sorig. were found - - - - - - - - -	1
Light grey flaggy chalk, with irregular marly veins and partings, exposed for - - - -	5

The dip here is approximately north-eastward at 15° (see Fig. 4).

---

* Geology of the Country around Hungerford (Sheet 267), page 12, 1906.

The tract which comes into the map west of East Woodhay is probably an inlier, but may possibly be connected with the eastern end of the Ham and Shalbourn inlier by a narrow neck of outcrop north-east of Walbury Camp. There are few exposures of Lower Chalk in it, but Mr. Bennett found hard greyish chalk in a small pit about a mile west of East Woodhay Church at a level of about 660 feet and flaggy grey chalk in the lane leading north-eastward.

In the Vale of Kingsclere the only good exposure of the Lower Chalk is that in the cutting on the railway south of Burghclere Station. No complete notes of this exposure have come into my hands, but it will be seen from the geological map that the beds are here dipping about 4 degrees to the south, and that they must be in the central part of the Lower Chalk, those near the bridge being about sixty feet below the Melbourn Rock.

Mr. Rhodes collected fossils from this cutting in 1885, and observed that the lower marly beds on the north were divided from the higher beds of greyish blocky chalk by a bed of hard grey stony chalk, which reminded him of the Totternhoe Stone. Moreover, when the fossils had been named by Messrs. Sharman & Newton, it appeared that the lower beds contained the fauna of the *Schloenbachia varians* zone while the higher beds yielded *Discoidea cylindrica* (Lam.), *Cidaris bowerbanki* Forbes, and a badly preserved *Holaster* with others which are common in the zone of *Holaster subglobosus*. The bed of hard chalk, therefore, seems to divide the one zone from the other, just as the Totternhoe Stone does in the counties north of the Thames. Further, it contains *Rhynchonella mantelliana* (J. de C. Sow.), *Pecten orbicularis* J. Sow. and *Plicatula inflata* J. de C. Sow., which are also common fossils in the Totternhoe Stone.

Slides were prepared from small pieces of this hard bed and were sent to Mr. W. Hill for examination and comparison with Totternhoe Stone. His report on its structure is as follows:—"This chalk as seen in thin section under the microscope exhibits characters which closely resemble those of the Totternhoe Stone. It consists chiefly of shell-fragments, with Foraminifera, grains of glauconite and quartz, closely packed in an amorphous matrix. All these particles are very even in size, and though they are all slightly larger than those occurring in the building-stone at Totternhoe, in general appearance and in evenness of grain the rock compares very closely with that stone.

"Compared with the hard beds at Eastcott, Collingbourne, and other places in Wiltshire, this bed differs by the complete absence of colloid silica and rarity of sponge spicules. There may be occasional residuary spicules, but they are not common as they are in the beds above mentioned. This bed has in fact the characteristic structure of Totternhoe Stone."

The following list of fossils from the Lower Chalk of Burghclere has been compiled partly from those collected by Mr. Rhodes and named by Messrs. Sharman & Newton, and partly from a list communicated by Mr. R. M. Brydone. The species found only by the latter are indicated by the letter B.

———	Basal. Bed.	Railway Cutting.			Pit S.W. of Burgh-clere.
		Chalk Marl.	Hard Beds.	Chalk above.	
Pisces.					
Beryx sp.	–	–	–	x	
Enchodus sp.	–	–	–	x	
Lamna sp. -		–	–	–	x
Ptychodus decurrens *Ag.*		–	–	x	
Cephalopoda.					
Calycoceras naviculare (*Mant*).	x				
Metacanthoplites rotomagensis (*Brongn.*) -	–	x			
Schloenbachia varians (*J. Sow.*)	x	x			
„ coupei (*Brongn.*)	–	x			
Baculites sp. -	–	B			
Gasteropoda.					
Pleurotomaria sp.					
Turritella sp. -					
Lamellibranchiata.					
Inoceramus latus ? *d'Orb.* non *Mant.*	–	x			
„ sp. - -	x	x	x	x	
Lima (Plagiostoma) globosa (*J. de C. Sow.*) - -	–	x	–	B	
Ostrea vesicularis *Lam.* -	–	B	–	x	x
Pecten (Syncyclonema) orbicularis *J. Sow.*	–	B	x		
Plicatula inflata *J. de C. Sow.*	–	x	x		
Brachiopoda.					
Rhynchonella grasiana *d'Orb.* -	x ?	x			
„ mantelliana (*J. de C. Sow.*)	–	B	x		
„ martini *Mant.* -	–	B			
Terebratula semiglobosa *J. Sow.*	–	B	x	x	x
Crustacea.					
Enoploclytia sp. - -	–	–	–	x	
Echinodermata.					
Cidaris bowerbanki *Forbes*	–	–	–	x	
Discoidea cylindrica (*Lam.*) -	–		–	x	
Glyphocyphus radiatus *Hœn.*	–	–	–	–	x
Holaster lævis *Deluc*	x				
„ sp. -	–		–	x	
Anthozoa.					
Micrabacia coronula (*Goldf.*)	–	–	x		

MIDDLE CHALK.

The Middle Chalk, as defined on p. 13, is well marked off from the other stages both by the rocky bands which lie at its base and top, and by its fossils which, though not very numerous, are different from those found in the Lower Chalk, while very few of them range into the Upper Chalk.

This stage is divisible into two zones, (1) that of *Rhynchonella cuvieri* which has at its base a band of hard nodular chalk known as the Melbourn Rock, and (2) the zone of *Terebratulina* which forms the upper part of the stage.

The Melbourn Rock where unweathered is a hard chalky limestone lying in two or three massive beds which are together from 8 to 10 feet thick, but at the outcrop these weather into a chalk that is full of hard nodular lumps varying in size from that of a marble to that of a walnut or an egg, but irregular in shape.

These rocky beds pass up into chalk of a creamy colour in which the nodules are small and less frequent, but this chalk still has a rough and nodular character. In this chalk two fossils are generally of common occurrence, *Rhynchonella cuvieri* d'Orb. and *Inoceramus mytiloides* Mant.

The succeeding beds (zone of *Terebratulina*) consist of firm white chalk, homogeneous and free from nodules, lying in thick beds with occasional thin layers or seams of grey marl. Flints also occur but at distant intervals and there are seldom more than three or four layers of them in the whole zone.

The little *Terebratulina* found in this zone was formerly identified with *Ter. gracilis*, but that is now recognised as a species belonging to the highest part of the Upper Chalk. The form in the Middle Chalk is that which was described by Mr. Etheridge as *Terebratulina gracilis*, var. *lata*. Among other fossils *Inoceramus cuvieri* (J. de C. Sow.) and *Conulus subrotundus* Mant. often occur, while *Spondylus spinosus* (J. Sow.) makes its first appearance, but fossils are seldom abundant in this part of the Chalk.

In the western part of the area the total thickness of the Middle Chalk is probably not more than 120 feet of which about half may belong to the *Rh. cuvieri* zone, but the thickness increases westward and round the vale of Kingsclere it appears to be about 150, this increase being chiefly in the higher zone, that of *Rh. cuvieri* not exceeding 50 or 60 feet.

The Middle Chalk enters the area near Collingbourne Kingston and runs south of Wexcombe and Tidcombe curving thence round the eastern end of the Vale of Pewsey. By a narrow neck or *col* its outcrop communicates with that which surrounds the Shalbourne inlier.

Near Combe it again comes to the surface and forms a long inlier stretching down the valley to Hurstbourne Tarrant where it unites with a still narrower outcrop extending from Vernhams Dean to Stoke.

Another inlier over two miles long occurs in the Valley from Ashmansworth northward and still further east is another outcrop around the inlier of Lower Chalk near East Woodhay.

Lastly it surrounds the Lower Chalk of the Burghclere district, its outcrop there being for the most part narrow except to the north of Lichfield where it widens out into a tract which occupies about two square miles.

Notes of Exposures.

The most complete section of the Middle Chalk is that in the cutting made in 1902, for the railway siding from the Dods Down Brickworks, which are just outside the north-west corner of the area near Wilton. This was examined by Mr. Osborne White, from whose account in the Memoir on the country around Hungerford the following details and illustration (Fig. 4) are taken.

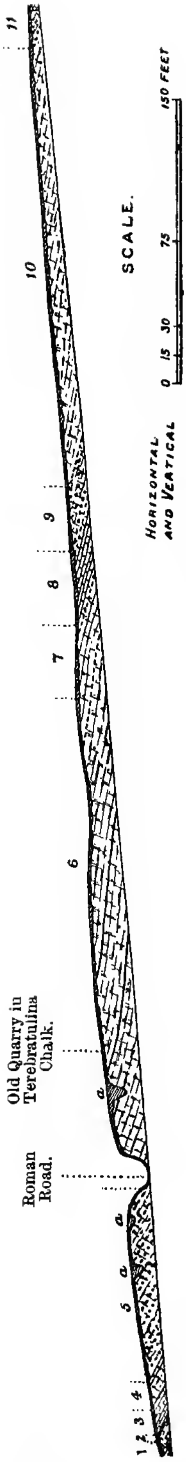


Fig. 4.—*Section along the Railway Siding to Dods Down.*

a a a—Hollows filled with recent shelly loam.

			Feet.
Upper Chalk.	Zones of *Micraster coranguinum* & *M. cortestudinarium.*	11 & 10. White Chalk, with numerous flints. For description see page 24 -	230
	Zone of *Holaster planus.*	9. Hard, nodular and lumpy chalk, with a few fossils -	10
		8. Hard but rubbly cream-coloured chalk, with 5 rows of green-coated nodules (*Chalk Rock*)	12
Middle Chalk.	*Terebratulina* Zone.	7. Hard, lumpy and nodular greyish chalk - - -	8
		6. Firm, blocky and flaggy, white and greyish chalk, with grey marly bands and seams of marl. *Terebratulina gracilis*, var. *lata*, Eth.	60
	Zone of *Rhynchonella cuvieri.*	5. Hard, very lumpy and nodular light-grey chalk, containing *Inoc. mytiloides* Mant., *I. cuvieri* J. de C. Sow.; *Rhynchonella cuvieri* d'Orb.; *Terebratula semiglobosa* J. Sow; and *Discoidea dixoni* Forbes -	36
		4. Greyish, flaggy chalk, nodular in places, with 3 seams of grey marl, one of them at the top- -	16½
		3. Hard, yellowish to greyish chalk, with many closely set courses of yellowish brown nodules -	6

Lower Chalk 1 and 2 as described on page 15 6

The prevailing dip is north-eastward at angles of 15° to 20° in the lower part, and of 10° to 12° in the higher part of the cuttings.

The cutting for the railway just north of Collingbourne Kingston must have traversed the Melbourn rock, but is now talused. Its base however is exposed in the road north of New Buildings about a mile north-north-east of Collingbourne, where Mr. Bennett saw about two feet of hard cream-coloured nodular chalk resting on soft greenish-grey marl.

Mr. Bennett found the soft white massive chalk of the *Terebratulina* zone exposed in the road cutting east of Brunton and still better in the road from New Buildings to Fairmile Down. South of Wexcombe he saw a little hard nodular chalk at about 650 feet, but this is probably a slipped mass. At the foot of Wexcombe Down there is a small pit described by Mr. Bennett as showing 10 feet of white chalk much broken and without flints; this is probably part of the zone of *Rh. cuvieri.*

No good exposures were seen along the southern side of the Shalbourn inlier, but traces of the Melbourn rock were seen in some of the road cuttings and along the outcrop which connects this with the west of East Woodhay. About a mile south of the latter place are two quarries, one of which was open in 1902 when it was visited by the Geologists Association; reporting on this visit, Mr. Osborne White remarks that "a short distance to the north west of this spot the axis of the anticline, which elsewhere follows the foot of the Chalk escarpment, runs obliquely into the face of the downs. The beds exposed in this pit consequently dip outwards instead of inwards, facilitating quarrying operations to a dangerous degree. The director commented on this unusual coincidence of an 'escarpment' with a dip slope. The Middle Chalk shown here had the usual massive character, save near the eastern end of the section, where there were abundant signs of crushing and faulting. A ferruginous cast of a sponge, somewhat resembling the Lower Chalk form *Plocoscyphia meandrina,* was the only fossil found which is worthy of note."*

The Combe and Ashmansworth inliers have been mapped by tracing the outcrop of the Chalk Rock and no noticeable exposures of the Middle Chalk were observed.

In the Kingsclere district the thickness of the Middle Chalk is decidedly greater than it is in the Vale of Pewsey and is probably about 150 feet. It occupies a considerable surface area around Beacon Hill south-west of Burghclere, but the only exposures seen by Mr. Bennett were along the line of railways; of these he writes: —the second cutting north of Litchfield is in soft white chalk with occasional flints and a few fossils which have been identified as *Micrabacia sp.*, *Terebratulina gracilis,* var. *lata* Eth., *Terebratula semiglobosa* J. Sow. and an *Inoceramus.* The third cutting, further north, shows the base of the Melbourn Rock (hard nodular chalk) resting on yellowish marl; the following fossils were obtained from it by Mr. Rhodes, *Ostrea normaniana* d'Orb., *Terebratula semiglobosa, Terebratulina striata* Dav., and *Discoidea dixoni* Forbes.

The Melbourn Rock is also exposed in the roadway south of Sydmonton.

---

* *Proc. Geol. Assoc.*, vol. xvii., p. 394 (1902).

Along the northern border of this area the outcrop or basset surface of the Middle Chalk is very narrow, owing to the high inclination of the beds There is a quarry by the road-side three-quarters of a mile north of Sydmonton in which Mr. Bennett saw about 25 feet of chalk the lowest part firm and massive with dark greenish veins; this is probably the top of the Melbourn Rock.

The highest portion of the zone of *Terebratulina* can be seen in the road cutting at the bottom of the hill south-east of Stoke in the Mary Bourne valley. This section is described on p. 26 and Mr. Osborne White has recently obtained the following species from the chalk below the marl band:—*Inoceramus cuvieri* ? J. de C. Sow., *Ostrea normaniana*, *Dimyodon nilssoni* (Hag.), *Spondylus spinosus* (J. Sow.) (common), *Terebratula semiglobosa* (common), *Ter. carnea* J. Sow., *Terebratulina gracilis*, var. *lata* (common), *Micraster corbovis* Forbes, and *Porosphæra globularis* (Phill.).

CHAPTER IV.

UPPER CHALK.

The full thickness of the Upper Chalk is not found in this part of Hampshire, because the highest portion of it appears to have been removed before the deposition of the Reading Beds. A study of the zones of the Upper Chalk has demonstrated the existence of a marked unconformity between the Cretaceous and Eocene systems in this country and has also shown that in passing northward from the Hampshire to the London Basin the base of the Eocene gradually oversteps the zones of *Belemnitella mucronata* and *Actinocamax quadratus* till it rests on the underlying *Marsupites* zone.

As a result of this overstep the total thickness of the Upper Chalk in the north of Sheet 283 is only about half its thickness below the Eocene of South Hampshire. Thus between Portsdown and Winchester its thickness is probably about 800 feet while near Highclere and Kingsclere, where it rests on the zone of *Marsupites*, it is only about 400 feet.

According to the zonal classification now adopted by the Geological Survey the zone of *Holaster planus* is regarded as the basal part of the Upper Chalk, and where the Chalk Rock is developed its outcrop has been taken as the line of division between the Middle and Upper Chalk. This view, that the base of the Chalk Rock coincides with the base of the *Holaster planus* zone, has been confirmed by the recent work of Messrs. Chatwin and Withers in the Thames Valley.†

Within the area of Sheet 283 the following zonal divisions of the Upper Chalk are represented, the thicknesses given being approximate:—

		Ft.
5.	Zone of Actinocamax quadratus	about 100
4.	„ „ Marsupites -	„ 100
3.	„ „ Micraster coranguinum	„ 220
2.	„ „ Micraster cortestudinarium-	„ 60
1.	„ „ Holaster planus	20 to 30
		about 500

Figures 5 and 6 illustrate the manner in which the higher parts of the Chalk come in as the beds are followed from the north-east to the south-west, *i.e.*, from Burghclere to Andover.

Zones of Holaster planus and Micraster cortestudinarium.

It will be convenient to describe the exposures of these two zones together, because the lower zone is so thin that where it is exposed more or less of the overlying chalk is generally seen.

In this northern part of Hampshire the Chalk Rock is fairly well developed but is very variable in thickness. It consists of several beds or courses of hard cream-coloured limestone, each having a layer of green-coated nodules at the top; these nodules are composed of hard compact yellowish chalk and are slightly phosphatic. The rock itself often contains grains of dark green glauconite: it varies from 2 to 12 feet in thickness.

---

† See *Proc. Geol. Assoc.*, vol. xx., pp. 412 and 415 (1908).

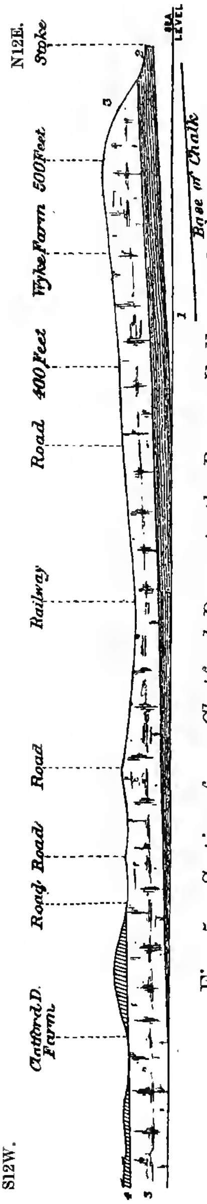


Fig. 5.—*Section from Clatford Down to the Bourn Valley at Stoke.*
Horizontal scale, one inch to the mile. Vertical scale, 1,400 feet to an inch.

4. Zone of *Marsupites*.
3. Lower Zones of Upper Chalk.
2. Middle Chalk.
1. Lower Chalk.

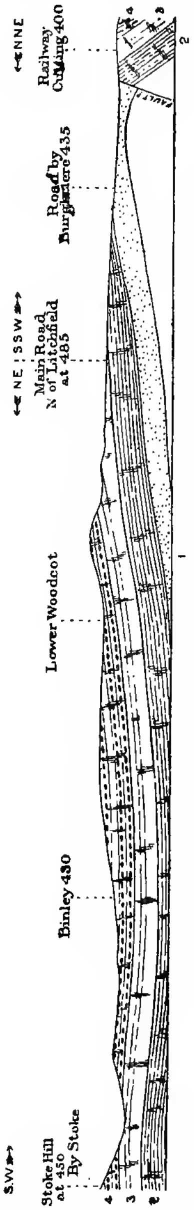


Fig. 6.—*Section from Stoke Hill to Burghclere, across the Kingsclere anticline.*
Horizontal Scale, one inch to a mile. Vertical Scale, 1,400 feet to an inch.

4. Upper Chalk.
3. Middle Chalk.
2. Lower Chalk.
1. Selbornian.

There are some grounds for inferring the existence of a fault north of Burghclere, although it is not marked on the map.

Above the rock-bed there is generally from 10 to 14 feet of rough nodular greyish chalk in which fossils are more uniformly present, *Spondylus spinosus* (J. Sow.), *Terebratula carnea* J. Sow., *Echinocorys scutatus* Leske and *Holaster placenta* Ag. being common. To this succeeds a single bed of hard cream coloured limestone, the upper surface of which is probably very near if not actually the palæontological summit of the zone.

The zone of *Micraster cortestudinarium* consists of firm white flaggy chalk in which fossils are scarce, but flints are very numerous occurring both in layers of nodules and in the more or less continuous sheets or floors which are known as "tabular flint." The thickness of this zone is uncertain, because no one has yet been able to spend sufficient time in searching for fossils in order to fix the plane where the Micrasters with inflated and subdivided ambulacral areas die out; for according to Dr. A. W. Rowe this is the only reliable guide. Probably the thickness is between 50 and 60 feet.

Notes of Exposures.

The outcrop of the Chalk Rock has been traced round the eastern end of the Vale of Pewsey, but no good exposures of it were found. The following notes are taken from Mr. Bennett's field maps.

The outcrop runs below the gravelly floor of the Avon valley at Sunton, north of Collingbourne Ducis, and is traversed by the short railway cutting east of Sunton Farm; a new cut in 1894 showed the upper part of the rock with a layer of green coated nodules at the top, passing under white chalk with flints. Small exposures were also seen in the bank of the main road half a mile east of Tidcombe church, and in the road cutting on the hill north-east of Wilton. It is also exposed in the siding which leads to Dods Down Brickyard (*see* p. 19), where the zone of *Holaster planus* appears to be 22 feet thick. Mr. Osborne White informs me that above the outcrop of the Chalk Rock the cutting is shallow and talused so that he was unable to determine the exact limits of the zones. In the overlying chalk (zone of *M. cortestudinarium*) layers of tabular flint are a conspicuous feature.

No good sections were seen in the country which intervenes between the Vale of Pewsey and that of Kingsclere, but in the latter district there are several exposures. The best and most accessible of these is in the first cutting on the railway north of Litchfield Station, which exposes nearly the whole of the beds that are referable to this zone. The following description is communicated by Mr. W. Whitaker from notes taken in 1885. The beds dip at about 4° to the south and the succession is:—

	Ft.
6. White chalk with flints	–
5. Very hard pale cream-coloured chalk, with a few pale greenish nodules about	3
4. Whitish lumpy chalk (in parts very hard), with two thin discontinuous flint layers, and a layer of flint nodules near the base	12
3. Hard-jointed chalk-rock with green coated nodules, especially at top, where it is fossiliferous	2
2. Hard chalk somewhat rocky about	4
1. Hard chalk-rock with green nodules, passing down into hard chalk	1
	22

The base of the zone has not been fixed with any certainty, for no fossils were found in the lowest beds, but these probably belong to the *Terebratulina* zone. For fossils found here *see* p. 28.

A similar succession of beds is exposed at the southern end of the railway cutting about a mile north of Burghclere, the succession being as follows:—

	Ft.
Upper rock-bed	2
Greyish nodular chalk	14
Lower rock-bed	3
Greyish nodular chalk	10

Mr. Rhodes obtained many fossils from the lower rock here but only a few from the higher beds.

Another exposure is shown in the quarry by the side of the main road east of the railway. Here the beds dip to the north at about 26°, as marked on the map. For the following notes on this section I am indebted to Mr. Osborne White, who examined it in 1905.

The beds here exposed in descending order are:—

	Ft.	In.
5. White chalk with flints, blocky above but rather lumpy in the lower part	16 to 18	–
4. Hard yellow limestone with a layer of green-coated nodules at top	–	3
3. Greyish chalk, nodular and lumpy in ill-defined beds	14	
2. Massive cream-coloured Chalk-rock, containing two layers of green-coated nodules	1	6
1. Greyish nodular chalk, badly exposed	20	–

Several examples of *Micraster præcursor* Rowe, were found in the lowest 3 feet of Bed 3, and belonged to the "sutured" and "feebly inflate" varieties of Dr. A. W. Rowe. Above this horizon Micrasters were scarce. The other fossils found in these nodular beds are given on p. 28.

A few inches above the upper rock-layer a rather "strongly inflate" example of *Micraster præcursor* was found, and about a foot higher is a band in which the same *Micraster* is common, and all the examples are of the "subdivided" type which is characteristic of the *M. cortestudinarium* zone. About 10 feet higher still other examples were found of the same subdivided type. It would seem, therefore, that the palæontological division-line between the zones coincides very closely with the upper surface of the rocky layer. Other fossils found by Mr. White in the higher zone were *Inoceramus involutus* J. de C. Sow., *Inoceramus sp.* (small, curved), *Terebratula semiglobosa* J. Sow., *T. carnea* J. Sow., and *Holaster placenta* Ag. Flints are numerous, occurring both as nodules and in thick semi-tabular layers.

Mr. White also informs me that he thinks that the chalk of the *M. cortestudinarium* zone is exposed in the quarry about five furlongs west of the railway cutting on the south side of the road, where the dip 35° is marked on the map. The chalk seen here is rough and blocky in the upper part, lumpy and greyish below, and barren. Flints are numerous, but mostly small, and nearly all are zoned with a violet tint.

At Kingsclere there is a quarry at the cross-roads about three furlongs south-west of the church, of which Mr. Bennett has the following note—at the base is a bed of hard Chalk Rock with a layer of green-coated nodules at the top; above this is greyish chalk (12 to 15 feet), overlain by white chalk with flints. The beds are dipping at 20° to the north. Comparing this description with those above given it would seem that the upper rocky layer is absent here and that the uppermost beds belong to the zone of *M. cortestudinarium.*

The only other noteworthy exposure of the zone is that in the road-cutting south-east of Stoke near St. Mary Bourne. This was seen and measured many years ago by Mr. E. Westlake, whose description of it was published in Dr. J. Stevens' "History of St. Mary Bourne" (1888), and was quoted in the General Memoir on Cretaceous Rocks, Vol. III., p. 186 (1904). It was felt, however, that the section ought to be examined again by someone who was familiar with recent advances in our zonal knowledge of the Chalk and Mr. Osborne White kindly consented to visit the place. This he was able to do in September, 1906, and the following account is based on the observations which he then made and communicated to me. He found that the higher beds were partly obscured by talus, but he was able to clear portions of the face and to confirm Mr. Westlake's description except in regard to certain details of the lower beds of which a fuller account is given below. Mr. White's reading of the section is as follows:—

	Ft.	In.
10. Soft chalk, jointed rectangularly, with some flints	3	9
9. *Upper Rock-Bed.* Very hard chalk, rather broken up but well-defined at the top -	2	–
8. Mixed hard and soft chalk, partly blocky and white, partly lumpy, and yellowish where hardest. A few small flints far apart in courses and others scattered	8	–
7. *Sponge-Bed.* Hard nodular coarse-grained chalk with black specks; a layer of rusty flints at the top, and many irregular decayed flints full of spicules and glauconite grains. In places the chalk is powdery and contains cavities; it also abounds in chips of Echinoderm shell -	1	–
6. *Chalk Rock.* Two courses of very hard yellowish chalk, each of which has an irregular but well-defined surface, formed by a layer of green-coated nodules with some decomposed pyrites-concretions - -	2	10
5. Nodular chalk consisting of hard lumps in a softer matrix with wavy streaks of grey marl -	2	8
4. Hard yellowish sub-rocky chalk with a layer of green-coated nodules at the top - - 9 inches to	1	–
3. Firm to hard nodular chalk with a thin course of green nodules about 3 feet from the base -	5	6
2. Soft grey laminated marl forming a conspicuous feature	–	4
1. Greyish-white chalk, nodular in the upper part, softer and more blocky below with several thin seams of marl. *Terebratulina lata* is abundant in the upper part about	20	–
,,	47	1

If the above description be compared with that given in the General Memoir, it will be seen that the bed described by Mr. Westlake as a separate layer of green-coated nodules should be regarded rather as the top of a bed of yellowish rocky chalk (No. 4). Mr. White considers this bed to be the equivalent of the lowest part of the Chalk Rock of Oxfordshire, and takes the three beds numbered 4, 5, 6 (with a combined thickness of over 6 feet) to represent the Chalk Rock of Henley, which has nearly the same thickness. The occurrence of a *Natica* in Bed 5 lends some support to this view.

If Bed 4 be regarded as the base and the upper rock-bed as the top of the zone, its full thickness here is 17½ feet. The fossils obtained by Messrs. Westlake and Osborne White from the more fossiliferous parts of the section are included in the following list and are marked "s".

From Bed 1 Mr. Westlake obtained many fish remains and some other fossils, but no Micrasters. In Bed 3 he found a *Micraster* which he identified as (*M. breviporus*), and *Terebratula semiglobosa* J. Sow. No fossils were found in Bed 4, but in Bed 5 *Holaster planus* Mant. and *Micraster leskei* Desm. occurred. In Beds 6, 7, and 8 he found many fossils (*see* list below), but in No. 9 a species of *Micraster* was the only one seen.

Here, as at Litchfield, the special fauna of the zone of *Holaster planus* does not set in till the thick bed of Chalk-rock is reached. Consequently I am disposed to refer the lower beds (Nos. 1 to 5). to the zone of *Terebratulina* and to compare the green-coated nodules (No. 4) with the similar bed which occurs near the top of that zone in the Isle of Wight. If this is correct it follows that only Beds 6 to 9, with a total thickness of nearly 14 feet, can be referred to the zone of *Holaster planus*, the chalk between the two rock-beds being thinner here than it is at Litchfield and Burghclere.

List of Fossils from the Localties above described.

Mr. Rhodes obtained fossils from the exposures above mentioned at Kingsclere, Burghclere, and Litchfield, and these were named by Messrs. Sharman and Newton. Mr. Westlake also collected many from these sources, and the letters indicate localities as follows,—k = Kingsclere, b = Burghclere, l = Litchfield, s—Stoke. Those collected by Mr. H. J. O. White from the quarry north of Burghclere and not found also by Mr. Rhodes are indicated by a capital B, and additional species found by Mr. White at Stoke Hill by a capital S.

	Zone of *Holaster planus.*			Zone of *Micraster cortestudinarium.*
	Lower rock-bed.	Nodular Beds.	Upper rock-bed.	
Pisces.				
Oxyrhina mantelli *Ag.*	—	s		
Cephalopoda.				
Pachydiscus peramplus *Mant.*	b l s			
Baculites bohemicus *Fritsch*	l s			
Heteroceras sp.	b l			
Nautilus sublævigatus *d'Orb.*	s	b s		
Scaphites geinitzi *d'Orb.*	b l			
Gasteropoda.				
Aporrhais sp. (cast)	b			
Avellana sp. (cast)	b			
Cerithium saundersi ? *Woods*	l			
Natica sp.	k l			
Pleurotomaria perspectiva ? *Mant.*	b l s	s	l	
Trochus schlüteri *Woods*	b l			
Solariella gemmata (*J. de C. Sow.*)	s			
„ sp.	b l s			
Lamellibranchiata.				
Arca sp. (small)	s			
Cyprina equisulcata *Woods*	S			
Inoceramus cuneiformis ? *d'Orb.*	s	s		
„ cuvieri ? *J. de C. Sow.*	s			
„ involutus *J. de C. Sow.*	—	—	—	B
„ sp. (small, curved)	b l	B s	—	B
Trapezium trapezoidale (*F.A. Ræm.*)	b l			
Lima sp.	b			
Septifer lineatus *J. de C. Sow.*	b s			
Ostrea canaliculata *J. Sow.*	s			
„ hippopodium *d'Orb.*	s			
Spondylus spinosus (*J. Sow.*)	b s	k b l s	b l	
„ sp.	—	s		
Brachiopoda.				
Rhynchonella cuvieri *d'Orb.*	b l			
„ plicatilis (*J. Sow.*)	b l s	s		
„ reedensis *Eth.*	b l s	k s		
Terebratula carnea ? *J. Sow.*	S	B s	—	B
„ semiglobosa *J. Sow.*	k b l s	k b l s	b l	B
Annelida.				
Serpula ampullacea (*J. de C. Sow.*)	—	—	—	k
„ fluctuata *J. de C. Sow.*	—	k		
„ gordialis ? *Schloth.*	s			
Echinodermata.				
Bourgueticrinus sp.	—	S		
Echinocorys scutatus *Leske*	—	k b l s	b l	k
Holaster planus (*Mant.*)	B	l		
„ placenta *Ag.*	—	B s	—	B
Micraster cortestudinarium (*Goldf.*)	—	k		
„ leskei *Desm.*	k b l s	l s		
„ præcursor *Rowe*	—	B l S	S	B k
„ sp.	—	b	b s	
Pentacrinus sp.		S		

	Zone of *Holaster planus.*			Zone of *Micraster cortestudinarium.*
	Lower rock-bed.	Nodular Beds.	Upper rock-bed.	
Anthozoa.				
Caryophyllia cylindracea (*Reuss*)		b		
Parasmilia centralis (*Mant.*)	s	B s		
Coral (small species) -	s			
Spongiæ				
Porosphæra globularis (*Phill.*)	l			
Ventriculites cribrosus ? (*Phill.*)	—	s		
„ impressus *T. Smith* -	b l	b		
„ mammillaris *T. Smith*	l			
„ radiatus, *Mant.*	—	—	b	
„ sp. -	—	k b s		

The Zone of Micraster coranguinum.

This zone comprises the greater part of the Upper Chalk that comes within our area, for its thickness is more than 200 feet. It consists of soft white close-grained chalk, which is generally smooth, but sometimes roughened by the presence of broken bits of *Inoceramus*-shell. It contains frequent layers of flint-nodules, but few tabular or continuous layers; the flints are generally dark grey or black inside, but there is sometimes a band of cloudy white flint near the ontside, but separated from the outer crust by a thin band of grey flint: these are the *silex zonés* of Professor Barrois. Some of the beds contain cavernous flints, resulting apparently from the decay of enclosed sponges.

Fossils are not abundant in this zone, though a fair number of species may be found by diligent search in some parts of it. *Micraster coranguinum* Leske, *Conulus albogalerus* Leske, and *Cidaris perornata* Forbes, are characteristic and common species.

In the north-eastern part of the area the outcrop of this zone is a very narrow band on account of the steep inclination of the beds, but south of the Kingsclere anticline it occupies a broad tract, passing southward to and beyond the Valley of the Test. It also covers considerable space in the central part of the area, stretching westward to Ludgershall and Collingbourn Ducis, and south-westward to Amport and Monxton; but near Andover it passes beneath the higher zone of *Marsupites*.

The upper part of the zone of *M. coranguinum* is well exposed in a large quarry by the side of the main road to Newbury south of Whitway and near the entrance to Highclere Park. The beds here are dipping at 25° to the north, and I am indebted to Mr. Osborne White for the following particulars respecting the beds exposed:—

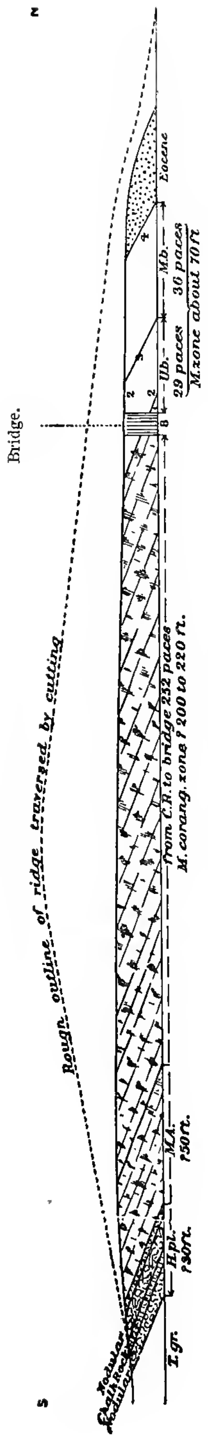


Fig. 7.—*Section through the Upper Chalk in the railway-cutting north of Burghclere.* (H. J. Osborne White).
Beds dipping north at from 20° to 25°.

M *b*—Marsupites Band.
U *b*—Uintacrinus Band.
MA—Zone of *M. cortestudinarium.*
H. pl.—Zone of *Hol. planus.*
T. gr.—Zone of *Terebratulina.*
4, *Actinocamax granulatus* found.
3, Layer with plates of *Marsupites.*
2, 2, *Uintacrinus* plates found.

The quarry is about 50 feet deep, and shows a thickness of at least 80 feet of chalk. The highest beds at the northern end belong to the zone of *Marsupites*, and form part of the *Uintacrinus* Band, but not more than 15 feet of these beds was exposed in 1905. They consist of soft white chalk with scattered flints and have yielded a few remains of *Uintacrinus* and *Bourgueticrinus*, with *Echinocorys scutatus* (ovate form), *Conulus albogalerus* (rounded form), a *Crania* and a Bryozoan.

The chalk below contains numerous flints and is of the usual character, but towards the southern end of the quarry and from 50 to 60 feet down in the zone of *M. coranguinum* there is a thin band (3 to 4 inches) of hard yellow limestone with about a foot of lumpy chalk below it. In these two bands spines and plates of *Cidaris clavigera* König are common. In the chalk just above the rock-band were found *Conulus albogalerus* and *Echinocorys scutatus* Leske, the latter of the pyramidal form, which is more often found in the *Marsupites* zone.

Mr. R. M. Brydone has also visited this quarry and has obtained a number of fossils from it, a list of which he has kindly placed at my disposal (*see* p. 36).

The cutting on the railway about half-way between Burghclere and Highclere stations traverses the whole thickness of Upper Chalk which here remains below the base of the Eocene. The section in this cutting has been roughly measured by Mr. Osborne White (*see* Fig. 7), and the following account is based on notes supplied by him.

The beds at the southern end dip north at 20° or a little more, the angle seeming greater because the sides of the cutting have a slope of nearly 40°. At the northern end the dip may be greater, but is now difficult to estimate in consequence of the weathering and talus. Mr. Irving, writing in 1888, stated that the dip of the Chalk at the northern end was 30°.* The central part of the cutting consists of white chalk with many layers of flints, the nodules being large in the lower beds, smaller above; these beds have not yet been properly searched for fossils, though Mr. Rhodes obtained some from the cutting, and many of them must have come from the zone of *M. coranguinum.*

It will be seen from Fig. 7 that the beds of this zone extend up to the bridge, where the road is carried over the line, and that all the chalk to the north of the bridge belongs to the zone of *Marsupites.*

By Mr. White's measurement the distance along the line from the Chalk Rock to the base of the Eocene was 317 paces (about 310 yards), and if we assume the average dip to be 25° this will bring in 394 feet of chalk. If the zone of *Marsupites* is 70 feet and the two lower zones are 80 feet thick, the thickness of the *M. coranguinum* zone will be about 240 feet, but it may be less.

About a mile east of the railway cutting and south of Cowhouse Farm is an old quarry, parts of which have been recently worked. This exposed parts of the zones of *Marsupites* and *M. coranguinum,* and Mr. White's account of the section will be found on p. 34.

Mr. White also furnishes the following notes on a quarry situate on the south side of the ridgeway road about a third of a mile west of Kingsclere—the chalk here contains a fair number of flints, and belongs to the upper part of the *M. coranguinum* zone. The beds dip at about 12° to the north. The chalk seems fairly fossiliferous, for in a few minutes he found the following fossils:—

Micraster coranguinum (*Leske*)
  and its variety *latior.*
Conulus albogalerus *Leske*
Echinocorys scutatus *Leske*
Bourgueticrinus (pyriform calyx).
Inoceramus cuvieri *J. de C. Sow.*
Crania ignabergensis *Retzius.*

Near Litchfield the dips are slight, and the beds appear to undulate somewhat. Professor Barrois observed a northerly dip of 5° at Cold Henley, but that at Larks Barrow it was dipping south at 3°. The existence of this little anticline is confirmed by Mr. Griffith of Winchester College, who informs us that he believes the whole railway cutting by Larks Barrow Hill and Cholesley Farm to be in the *M. coranguinum* zone, and that the beds at the northern end of the cutting are near the base of that zone, for they contain a form like *M. cortestudinarium* (Goldf.), while the chalk at the southern end is in the higher part of the zone.

---

* See *Quart. Journ. Geol. Soc.*, vol. xliv. p. 180.

The topmost beds, according to Messrs. Brydone and Griffith, are to be found in the cutting on the London and South Western Railway, north of Whitchurch, and have yielded a number of fossils (*see* p. 36); among the flints here are some large globular flints, which are hollow and full of powder. The whitening-pit at Whitchurch is probably also in these same topmost beds, and Professor Barrois states that the lower beds in this quarry contain cavernous flints, while those in the upper beds are zoned or banded. According to him also the same chalk occurs at Freefolk and at Overton, and though he was inclined to refer it to the zone of *Marsupites*, no plates of the Echinoderm have been found to the east of Whitchurch, and it seems probable that all the chalk to the east and south-east of Whitchurch belongs to the higher part of the *M. coranguinum* zone.

Another exposure which probably belongs to the upper part of this zone is that of the Beehouse pit east of Hurstbourne Priors. This was referred to the zone of *Marsupites* by Professor Barrois who called it the Cross Keys pit,* but Mr Westlake considered it to be within the zone of *M. coranguinum.*† The quarry has recently been visited by Mr. Osborne White (1906), who informs me that in his opinion the chalk here exposed is certainly within, but near the top of, the *M. coranguinum* Zone. He has communicated the following notes:—

The face of this quarry shows about 30 feet of rather fine soft white chalk with thin-rinded nodules of black flint in regular courses (but not very conspicuous), and many scattered, small, more or less globose, solid and spongy flints. Bits of stout Inoceramus-shell are abundant in the lower third of the section. About 20 feet up there is a band of friable gritty chalk rich in fragmental remains of Asteroids and Echinids. The middle beds much resemble, both in regard to appearance and the fossils they contain, the rough chalk about 20 feet below the summit of the *M. coranguinum* Zone exposed in the Cowhouse Farm quarry above mentioned (H. J. O. W.)

Fossils, with the exception of *Inoceramus cuvieri* J. de C. Sow., *Conulus albogalerus* Leske, a small *Ostrea* and fragments of Asteroidea, are not abundant, but a large number of species have been found by Messrs. Westlake, Brydone & White who have kindly communicated lists which are embodied in that given at the end of this chapter.

Professor Barrois mentions a pit near South-Side Farm at Middleton in the valley of the Test, of which he gives the following section, referring the chalk seen to this zone:—

		Ft.	in.
4. White chalk without flints - - -	about	3	0
3. Chalk with many layers of flint, which have hollows filled with sponge-spicules	„	16	0
2. Thick continuous layer of flint	„	0	2
1. Chalk forming the floor of the quarry.			

---

* Recherches sur le Terrain Crétacé Supérieur, p. 48 (1876).

† "Tabular Index of Upper Cretaceous Fossils cited by Dr. Barrois, (1888).

In No. 3 he found "*Serpula granulata, Spondylus dutempleanus, Sp. latus, Pecten cretosus, Echinoconus conicus, Echinocorys vulgaris* and *Micraster coranguinum.* The upper surface of this chalk, supporting No. 4, was indurated and waterworn."

West of Middleton towards Andover it passes below the superior zone of *Marsupites*, but I am informed by Mr. Brydone that the chalk exposed at Monxton and Amport appears to belong to this zone. At Monxton he has obtained fossils from a small cutting and excavation by the roadside in chalk, which contains hollow flints filled with white powder, and at Amport there is a large quarry, much overgrown, but showing white chalk with solid flints and very few fossils obtainable, probably rather a lower horizon than that at Monxton.

The Zones of Marsupites and Actinocamax quadratus.

It will be convenient to treat of these zones together, as the latter has only been recognised in one locality. The zone of *Marsupites* consists entirely of soft white homogeneous chalk, and the flints in it are less numerous and more scattered than in the zone below. Since the publication of the memoir on Cretaceous Rocks (vol. iii.) it has been ascertained by Messrs. Osborne White and Ll. Treacher that this zone has a continuous outcrop below the Eocene all along the Northern border of the Kingsclere anticline, and that it includes the subzone of *Uintacrinus.**

The existence of this zone near Hurstborne Priors and Andover was first made known by Professor C. Barrois in 1876;† more recently Messrs. C. Griffith and R. M. Brydone have explored that district, and have proved the extension of the zone westward as far as Appleshaw. There can be no doubt that the occurrence of this chalk and of still higher beds at comparatively low levels along this tract marks the existence of a synclinal flexure lying between the Pewsey-Kingsclere anticline on the north and the Stockbridge anticline on the south.

It is also nearly certain that the zone of *Marsupites* must be present in the range of hills which occupies the south-west corner of the area between Tidworth and Quarley, for this chalk is known to occur west of North Tidworth‡ at a height of 448 feet, and again in the railway cutting at Grately, just outside the southern border of Sheet 283 at a level of 368 feet, while the intervening hills reach from 400 to over 500 feet.

The full thickness of this zone in North Hampshire has not yet been ascertained, but there is not less than 70 feet of it north of Burghclere, where it is cut off by the Eocene, so that its thickness near Andover may well be 100 feet.

The zone of *Act. quadratus* consists of chalk with occasional layers of flints, and has only been identified near Andover.

---

* *Proc. Geol. Assoc.*, vol. xix., pp. 378–399 (1906).

† Recherches sur le Terrain Crétacé. Sup., p. 48.

‡ "The Geology of Devizes," *Mem. Geol. Survey*, p. 39 (1905).

Remarks on Exposures.

The exposure of the *Uintacrinus* Band near Whitway north-west of Burghclere, has been mentioned on p. 29, and Mr. Osborne White writes that there seems room for about 50 feet of the *Marsupites* Zone between its base in the quarry and the Eocene boundary, and that in this space there is a small chalk-pit now grassed over.

Messrs. White and Treacher supply the following observations on the chalk at the northern end of the cutting on the Didcot and Winchester Railway (*see* Fig. 7, p. 30). Just north of the bridge, plates of *Uintacrinus* and a nipple-shaped calyx of *Bourgueticrinus* were found; a little further on, at the point 3, a projecting layer of rough chalk yielded a plate of *Marsupites* and remains of *Ostrea*. At the point 4 an *Actinocamax granulatus* (Blainv.) was seen, but no other fossils except fragments of *Echinocorys*; in these highest beds elongate flints are common. The horizontal distance from where *Uintacrinus* occurs to the Eocene base is about 60 paces, and the thickness will be about 70 feet.

About a mile east of this railway cutting and a quarter of a mile south of Cowhouse Farm is a large old quarry in which there are several small exposures. These were examined by Messrs. White and Treacher, in 1905, and the former informs me that they show parts of the zones of *Marsupites* and *M. coranguinum*. He writes that it is a difficult section to measure, as the best faces are along the strike, flint bands are few, and there is a strong oblique jointing. The dip is 25° to the north-west, and the succession appears to be as follows:—

Zone of *M. coranguinum*, about 30 feet shown; *Conulus albogalerus* (Leske) is common in a band of rough chalk about 20 feet from the top, which is taken at a layer of pink flints. The *Uintacrinus* Band, consists of soft chalk with small scattered flints. Remains of *Uintacrinus* occur at intervals, but become very scarce within a few feet of the lowest plate of *Marsupites* seen. Estimated thickness, 24 to 25 feet. The *Marsupites* Band consists of similar chalk with scattered flints which have thick rinds and are grey inside. Plates of the name fossil are common and also imperfect pyramidal *Echinocorys*. The thickness seen was from 25 to 30 feet.

As Ecchinswell there is an old quarry south-east of the church, of which Mr. White reports that it shows the *Uintacrinus* beds on the north side, but much obscured by talus. On the south side there is chalk with many flints (zone of *M. coranguinum*), and the dip is 20° to a little east of north.

For the following notes on the places in the southern part of the area where these higher zones are exposed we are indebted to Mr. R. M. Brydone, except where it is otherwise stated.

The zone of *Marsupites* is brought in again along the southern part of our area by what may be called the Andover syncline. Thus the chalk traversed by the railway cuttings and tunnel north of Micheldever Station appears to belong to this zone, for

Mr. H. J. O. White informs me that tests of *Marsupites* collected by Dr. J. Stevens, and labelled " Micheldever " and " Micheldever Tunnel," are preserved in the Museum at Reading. Mr. C. Griffith, however, thinks that they cannot be common or that the *Marsupite* Band comes in near the tunnel, for he has collected from the cuttings and has not found a single plate of *Marsupites*, though *Actinocamax verus* Mill. is not uncommon and many other fossils were obtained (*see* list below). He describes the chalk seen in these cuttings as rather soft but solid, containing numerous flints of various shapes and sizes, which occur both in courses and as scattered nodules, their rinds varying in thickness from thin to rather thick. He also remarks that urchins of the genera *Echinocorys*, *Galerites*, *Micraster*, *Cyphosoma* and *Cidaris* ars remarkably abundant.

Professor Barrois records the occurrence of *Marsupites* on the borders of Harewood Forest (aux environs de la forêt d'Harewood) in chalk with rather large yellow-coated flints, but does not mention the exact place, and Mr. Brydone has not succeeded in discovering it. But there can be little doubt that the chalk on the north-west side of Harewood Forest does belong to that zone, for in the pit and road cutting down the slope of Bere Hill, east of Andover, Mr. Brydone has found *Offaster pillula* (Lam.) and *Terebratulina rowei* Kitchin, the first being a fossil which is rarely found below the zone of *Actinocamax quadratus*. The chalk in this and in another pit on the old Winchester Road, about half a mile south of Andover, he refers to the zone of *Act. quadratus*, and a list of the fossils he has obtained from them will be found on p. 36.

At the foot of Bury Hill west of Upper Clatford is a quarry in chalk which closely resembled that of the Beehouse Pit at Hurstbourne Priors, and has yielded a similar set of fossils—*Actinocamax verus* Miller. *Micraster coranguinum* (Leske), and *Conulus albogalerus* Leske, but no *Marsupites*. This is probably at the base of the *Marsupites* or the top of the *M. coranguinum* zone. Chalk with a similar set of fossils is also exposed in the railway cutting at Andover Junction.

Lastly, in a pit near the main road south-west of Appleshaw Mr. Brydone has found plates of *Uintacrinus*, which prove the chalk here to belong to the lower part of the *Marsupites* zone. In all probability this zone occupies the greater part of the area in the south-west corner of the sheet, but this has not yet been explored.

The following list of fossils from the zones of *Marsupites testudinarius* and *Actinocamax quadratus* in this part of Hampshire has been mainly compiled from local lists which have been generously placed at our disposal by Mr. R. M. Brydone. They include all the species found by him and Mr. C. Griffith at the localities named in the text, as well as some obtained from near Whitchurch by Mr. E. Westlake, and from the Beehouse Pit by Mr. White. The Bryozoa from the last locality were indentified by Mr. Ll. Treacher from material obtained by Mr. White.

LIST OF FOSSILS (UPPER CHALK).	Zone of *M. coranguinum.*					Zone of *Marsupites.*				Zone of *Act. quadratus.*	
	Highclere.	Whitchurch.	New Barn.	Monxton.	Beehouse Pit.	Micheldever.	Bury Hill.	Andover Junc.	Applesham.	Andover, E.	Andover, S.
Pisces.	1	2	3	4	5	6	7	8	9	10	11
Cimolichthys lewesiensis *Leidy*	1	–	–	–	–	6	–	–	–	10	
Corax falcatus *Ag.* -	–	–	3	–	–	6					
„ pristodontus ? *Ag.* -	–		–	–	5						
Enchodus lewesiensis (*Mant.*)	1	–	–	–	5		–	–	–	10	
Lamna appendiculata (*Ag.*) -	–	–	3	–	5	6					
„ semiplicata ? (*Ag.*)	–	–	3								
Oxyrhina crassidens *Dixon* -		–	3	–	–	6					
„ mantelli *Ag.*	–	2	–	–	–	6					
Ptychodus latissimus *Ag.*	–	–	3	–	–	6					
„ mammillaris *Ag.* -	–		3								
„ polygyrus *Ag.*	–	–	3	–	–	6					
Cephalopoda.											
Ammonites sp. - - -	–	–	–	–	5						
Actinocamax granulatus (*Blainv.*)	–	–	–	–	5	–	–	–	–	11	
„ verus *Miller*	–	–	–	–	5	6	7	8			
Gasteropoda.											
Pleurotomaria sp.	–	–	–	–		6					
Lamellibranchiata											
Avicula sp. - - -	–	–	–	–	5	–	–	–		10	
Inoceramus cuvieri ? *J. de C. Sow.*	1										
„ sp.	–	2	3	4	5	6	7	8	9	10	11
Lima hoperi (*Mant.*) - -		–	3	–	5						
„ (Limatula) wintonensis *Woods*	–	–	–	–	5	–	–	–	–	10	
Septifer lineatus (*J. de C. Sow.*)	–	–	–	–	5						
Ostrea acutirostris *Nilss.*	–	–	–	–		–	–	–	–	10	
„ canaliculata *J. Sow.* -	–	2	3	–	5	–	7	8	–	10	11
„ curvirostris *Nilss.*	–	–	3	–	5	–	–	–	–	10	
„ hippopodium *Nilss.*	–	2	–	–	5	–	–	–	–	10	
„ normaniana *d'Orb.*	–		–	–	5						
„ ungulata *Schloth.* - -	–	2									
„ vesicularis (*J. de C. Sow.*)-	1	2	3	–	–	–	7	–	–	10	11
„ wegmanniana *d'Orb.*	1	2	3	?	5	6	7	8	–	10	11
Pecten (Chlamys) cretosus *Defr.* -	1	2	–	–	5	6	7	8	–	10	
„ (Æquipecten) pexatus *Woods*	–		–	–	5	6	7				
„ (Neithea) quinquecostatus *J. Sow.* - - -	–	2	–	–	5	6	7	8			
Dimyodon nilssoni (*Hag.*) -	–	2	3	–	5	6	7		–	10	11
Spondylus dutempleanus *d'Orb.*	–	–	–	–	5	–	–	–		10	11
„ latus (*J. Sow.*) -	1	2	3	–	5	6	7	–	–	10	11
„ spinosus (*J. Sow.*)	–	2	3	–	5	6	7				

LIST OF FOSSILS (UPPER CHALK).	Zone of *M. coranguinum.*					Zone of *Marsupites.*				Zone of *Act. quadratus.*	
	Highclere.	Whitchurch.	New Barn.	Monxton.	Beehouse Pit	Micheldever.	Bury Hill.	Andover Junc.	Applesham.	Andover, E.	Andover, S.
Brachiopoda.											
Crania parisiensis *Defr.*	1	2	–		5	–	–	–	–	10	
„ egnabergensis *Retz.*	–	–	–			6					
Rhynchonella limbata (*Schloth.*)	–	–	–	–	5	–	–		–	–	11
„ plicatilis (*J. Sow.*)	1	2	–	–	5	6	7	–	–	10	
„ reedensis *Eth.*	1	2	3	4	5	6	7	8	–	10	11
Terebratula carnea *J. Sow.*	–	–	–			6					
„ obesa *J. de C. Sow.*	–	–	–	–		6					
„ semiglobosa *J. Sow.*	1	2	3	4	–	6					
Kingena lima (*Defr.*)	–	2	3	–	5	–	7	8	9	10	11
Terebratulina rowei *Kitchin*	–	–	–	–	–		–	–	–	10	
„ striata *Dav.*	1	2	3	–	5	6	7	–	–	10	11
Thecidium wetherelli *Morris*	1	2	3	–	5	6	7	8	9	10	11
Bryozoa.											
Berenicea polystoma (*F. A. Roem.*)	–	–	–	–	5						
Ceriocava ramulosa (*Mich.*)	1	2	3	–	5	6	–	–	9	10	
Clausa francqana *d'Orb.*	–	–	–	–	5						
Entalophora echinata? (*F. A. Roem.*)	–	–	–	–	5						
„ virgula *Hag.*	–	–	–	–	5						
Membranipora elliptica (*Reuss*)	–	–	–	–	5						
„ variabilis *d'Orb.*	–	–	–	–	5						
Onychocella depressa *d'Orb.*	–		–	–	5						
Reptomulticava mamillata (*d'Orb.*)	–	–		–	5						
Truncatula aculeata *Mich.*	–	–	–	–	5						
Crustacea.											
Pollicipes glaber *F. A. Roem.*	–	–	–	–	–	–		–	–	10	
„ sp.	–	2	–	–	–	–	7				
Annelida.											
Serpula ampullacea (*J. de C. Sow.*)	1	2	3	4	5	–	7	8	9	10	11
fluctuata *J. de C. Sow.*	1	2	3	–	5	6	–	8	–	10	11
gordialis *Schloth.*	–	–	–	–	–	6	–	–	–		11
„ granulata *J. de C. Sow.*	–		–	–	–	–	–	–	–	10	
„ ilium *J. de C. Sow.*	–	–	–	–	–	–		8			
„ plexus *J. de C. Sow.*	–	2	3	–	5	–	–	–	–	10	11
„ turbinella *J. de C. Sow.*	–	2	3	–	5	–	7	–	–	–	11
Echinodermata (Crinoidea and Asteroidea.)											
Bourgueticrinus sp.	1	2	3	4	5	6	7	8	9	10	11
Goniaster, plates of	–	2	–	4	–	6	7	8	9	10	11
Marsupites testudinarius (*Schloth.*)											
Metopaster parkinsoni (*Forbes*)	–		3	–	5	–					
„ uncatus (*Forbes*)	–	–	3								
Mitraster rugatus (*Forbes*)	1										
Ophiura serrata *F. A. Rœmer*	–	–	3	–	–	–	–	–	–	10	

LIST OF FOSSILS (UPPER CHALK).	Zone of *M. coranguinum.*					Zone of *Marsupites.*				Zone of *Act. quadratus.*	
	Highclere.	Whitchurch.	New Barn.	Monxton.	Beehouse Pit.	Micheldever.	Bury Hill.	Andover Junc.	Applesham.	Andover, E.	Andover, S.
Pentaceros bulbiferus (*Forbes*)	–	2									
„ pistilliferus, (*Forbes*)	–	2									
„ sp.	–	–	–	–	–	6					
Pentacrinus, sp.	–	2	3	–	5						
Pentagonaster megaloplax *Sladen*	–	–	–	–	5						
Pycnaster angustatus (*Forbes*)	1										
Uintacrinus sp.	–	–	–	–	–	–	–	–	9		
Echinodermata (Echinoidea.)											
Cardiaster pygmæus? *Forbes*	–	–	3								
Cidaris clavigera *König*	1	2	3	4	5	6	7				
„ hirudo *Sorig.*	1	2	3	4	5	6	7	–	–	10	
„ perornata *Forbes*	1	2	3	–	5	6					
„ sceptrifera *Mant.*	1	2	3	4	–	6	7				
„ serrifera *Forbes*	–	2	–		–	6					
Cidaris subvesiculosa? *d'Orb.*	–	–	–	–	–	6					
„ sp.	–	–	–	–	–	–	–	8			
Cyphosoma corollare (*Leske*)	–		–	–	–	6					
„ Königi (*Mant.*)	1	2	3	4	–	6	7	–	–	10	
„ radiatum *Sorig.*	–	2	3	–	–	6					
„ sp.	–	–	–	–	5	–	–	–	–	–	11
Conulus albogalerus *Leske*	1	2	3	4	5	6	7				
„ subrotundus *Mant.*	–	2	–	–	–	6					
Echinocorys scutatus *Leske*	1	2	3	4	5	6	7	8	9	10	11
Epiaster gibbus (*Lam.*)	–	2	3		–	6					
Infulaster excentricus (*Rose*)	–	2	–	–	5						
Hagenowia rostrata (*Forbes*)	1										
Micraster coranguinum (*Leske*)	1	2	3	–	5	6	7	8			
„ „ *var.* latior? *Rowe*	–	–		–	–	6					
„ sp.	–	–	–	4	–	–	–	–	–	–	11
Offaster pillula (*Lam.*)	–	–		–	–	–	–		–	10	
Helicodiadema fragile (*Wilts.*)	–	2	–	–	5						
Salenia granulosa *S. P. Woodw.*	–	2									
Anthozoa.											
Axogaster cretacea *Lonsd.*	1	2	–	–	5						
Epiphaxum auloporoides *Lonsd.*	–	2	–			6					
Parasmilia centralis (*Mant.*)	1	–		–	–	6					
„ sp.		2	–	–	–	–	–	8	–	10	11
Spongidæ.											
Cephalites paradoxus *Smith*	–	–	3								
„ subrotundus (*Mant.*)	–	–	–	–	–	–	7				
Cliona cretacea (*Portl.*)	–	–	–		5	–	7	–	–	10	
Pharetrospongia strahani *Sollas*	1	–	–		–		–	–	–	10	11
Porosphæra globularis (*Phill.*)	1	2	3	4	5	6	–	8	–	10	11
„ pileolus *Hinde*	1	2	3	4	5	6	7	8	–	10	11
„ nuciformis (*Hag.*)	1	2	3	–	5	6	7	8	9	10	11
Ventriculites impressus *T. Smith*	–	–	3								
„ sp.	1	2	–	–	5	–	7	–	–	10	

CHAPTER V.

EOCENE.

Between the Upper Chalk and the lowest member of the Eocene Series in this area there is a great break and unconformity, for not only are the higher zones of the Chalk absent, removed doubtless during the slow pre-Tertiary movement of upheaval; but the Thanet Sands which form the basal member of the Eocene Series in Kent and part of Surrey are also wanting in this district.

The area occupied by Eocene Beds within the area of Sheet 283 is only about ten square miles along its north-eastern border around Highclere and Ecchinswell.

In the *Lower Eocene* the lowest member of the Series is that known as the Reading Beds, which consist of variously coloured clays and sands, and have a thickness of 60 to 70 feet.

These are succeeded by the London Clay, which, however, is much thinner here than in the eastern and central parts of the London Basin, being only from 60 to 70 feet thick.

The Bagshot Beds are of little greater thickness, not exceeding 90 feet; so that the total thickness of the Lower Eocene in this district is only about 220 feet as compared with about 500 feet in the southern part of Hampshire.

The *Upper Eocene* consists of a variable group of clays and sands which were formerly called the Middle and Upper Bagshot Beds. Since there is no longer any doubt about the correlation of the Middle Bagshot with the Bracklesham Beds, the latter name is now adopted. The highest sands, however, are still called Upper Bagshot by the Geological Survey, although it is admitted that they are the equivalent either of the Boscombe Sands or of the Barton Clay. The total thickness of this Upper Eocene division is not more than 100 feet, but it must be remembered that it is incomplete, because the top of it is not reached in the district.

I. READING BEDS.

In this part of the London Basin these Beds consist of alternating and lenticular deposits of clay and sand. The clays are of many colours, grey, brown, red and purple, and frequently there is a mottled combination of some of these colours. The sands, too, are often brightly coloured, but sometimes white.

The basement-bed generally consists of a greenish sandy clay or clayey greensand, at the bottom of which, resting on the Chalk, is a layer of green-coated flints, some not rolled but of irregular shape, as if freshly derived from the Chalk, together with some small, rolled, green-coated pebbles. With these there are often more or less perfect oyster shells (*Ostrea bellovacina* Lam. and *O. tenera* J. Sow.).

The sands and clays which make up the mass of this division do not contain any fossils; the clays are of the kind which is often called *plastic clay*, and they have been found to contain soluble or gelatinous silica.

The following observations by Mr. H. W. Bristow are quoted from the Memoir on the London Basin*:—"From Inkpen to beyond Odiham the Reading Beds occupy only a narrow zone at the northern base of the Chalk Downs in consequence of the high northern dip. Thus in the lane from East Woodhay to Neath End there is only a distance of 88 yards from the Chalk across the Reading Beds (the red clays of which appear at 66 yards distance) to where the London Clay makes its appearance with septaria containing small fossil shells. Notwithstanding, however, the narrow space they fill, the beds in question are exposed in many more places than might be expected, in consequence of their economic value for sand and for tile-clays, for which they are frequently worked."

Exposures.

A good section of the upper part of the Reading Beds is exposed in the Hollington Brickworks in the eastern angle of the four cross-roads north-west of the name "Hollington" on the map. The excavations show a descending section through parts of the Lower Bagshot Beds, the London Clay and the Reading Beds, all dipping strongly to the north-east. (*See* Fig. 8.)

This section was measured and described by Mr. Osborne White in 1902,† and the following details of the Reading Beds and London Clays are taken from his account:—

		Feet
London Clay.	9. Yellow sandy clay in rabbit burrows -	about 25
	8. Greyish, brown-mottled clay with masses of clay ironstone and of grey concretionary marl - -	25
	Seam of very small black and white flint-pebbles; one inch - -	—
Reading Beds.	7. Grey sandy clay marly towards top	2½
	6. Dark grey or black clay -	2
	5. Dark grey sandy clays - - -	15
	4. Dull red and yellow mottled clay, becoming grey at top -	5
	3. Grey sands -	6
	2. Yellow and grey sandy clay	10
	1. Red and yellow sands (base not seen)	—
		90½

The base of the London Clay not being clearly defined here, it is difficult to say where the division should be placed. Mr. White was inclined to place it at the seam of pebbles as shown, but Mr. Whitaker thought that the junction occured a few inches lower down.

---

* The Geology of the London Basin, *Mem. Geol. Survey*, 1872, p. 102.

† *Proc. Geol. Assoc.*, vol. xvii., p. 394.

The Reading Beds were formerly well exposed in the brickyard at Highclere Street, where the late Sir J. Prestwich saw the following section * :—

		Feet.
London Clay.	Clay	12
	Basement-bed, large flint-pebbles in sand	1
Reading Beds.	Fine ochreous sand	10
	Mottled light-red, yellow and grey brick-clay, the upper part sometimes a red tile-clay	25
	Whitish sand	10
	Iron-sandstone	1

Mr. Bennett reports that the mottled clay is still worked here, but that at the time of his visit the section was not clear, and no measurements could be taken.

When the Didcot, Newbury, and Winchester Railway was made, a good section through nearly the whole thickness of these beds was exposed in the cutting a mile north of Burghclere Station. This was visited by Mr. Bennett in 1886, and he communicates the following note:—"The cutting shows nearly 60 feet of Reading Beds dipping to the north at 30°, and the succession of beds seen is as below:—

	Feet.
Brown and grey mottled clay	6
Fine white sand	18
Crimson, grey and brown mottled clay	4½
Brown, blue and purple clay	18
Greenish sandy clay with oyster bed at the base	10
Total	56½

Near the base there is a small fault with a throw of about 2 feet."

The upper part of the Reading Beds and their junction with the London Clay was formerly exposed in a brickyard half a mile west of Ecchinswell Church. The section was noted by Prestwich (*see* p. 43), and was seen later by Mr Whitaker, who remarked that the Reading Beds consisted of "pinkish-purple pipe-clay and white clay with yellow stains, and of white clays in thin beds with white sand above and below; dip about 30° towards the north. The upper sands are of a coarser nature than those below." This pit is not now worked.

The only outlier is a small patch on the ridge north-east of Combe, on the northern border of the area and at a height of from 885 to 900 feet. This has been mapped as Reading Beds because it consists of sands and mottled clays which were formerly worked for making tiles. Mr. Osborne White informs me that these beds lie in a slight depression or "swale" between the Camp and Combe Hill, and that they appear to have subsided into a basin or hollow formed by solution of the underlying chalk, so that the outlier is not exactly in its original position, but below the normal level and it is to this fact that it owes its preservation.

---

* *Quart. Journ. Geol. Soc.*, vol. x., p. 96 (1854).

2. LONDON CLAY.

In this western part of the London Basin this clay is described by Prestwich as consisting "of tenacious brown and bluish-grey clays with layers of *septaria* (large irregular-shaped nodular masses of clayey limestone with divisions, *or septa,* of calcspar or arragonite). . . . At its base the London Clay commonly contains a greater or lesser admixture of green and yellow sands, generally mixed with rounded flint-pebbles, and not unfrequently cemented by carbonate of lime into semi-concretionary tabular masses. These mixed beds, however, never exceed a few feet in thickness and pass upwards rapidly into the great mass of the London Clay." *

This basement-bed with its rolled flint pebbles is a useful means of separating the London Clay from the Reading Beds below. The pebbles are generally small, one or two inches long, but large ones of 12 or 14 inches in length are sometimes found and they are scattered irregularly through the sandy clay. Mr. Bristow observed that a peculiarity of these pebbles is "that, though on examination they appear to be in their original compact and perfect condition, yet, when struck with a hammer even a gentle blow, they fall to pieces, being traversed by minute cracks in all directions, dividing the stones into irregular fragments without, however, completely destroying the adhesion between the fractured surfaces." †

The natural colour of the London Clay is bluish-grey, and it is only near the surface where it has been weathered and decomposed that it assumes a brown hue, due to the oxidation of the protosalt of iron which it contains. In the blue clay this iron is probably in the state of carbonate, and the septaria appear to consist mainly of carbonate of lime with a variable proportion of carbonate of iron and an admixture of clay.

Owing to the small thickness of the London Clay in this area, its outcrop, where overlain by the Bagshot Sands, is very narrow, but round Ecchinswell and Kingsclere it occupies a larger space, for the high dips prevalent at its outcrop become less and less northward.

Notes of Exposures.

The lower part of the London Clay is exposed in the brickyard at Hollington (p. 44), but the upper part is now obscured. Mr. Osborne White tells me that there can hardly be a less thickness than 60 feet at that place. The lowest part and the basement bed are shown in the pit at the Highclere Kilns as already mentioned (*see* p. 41).

Part of the London Clay was traversed by the cutting for the railway about a mile north of Burghclere and a passage from sandy clay into Bagshot Sand was observed by Mr. Bennett at the southern end of the cutting east of Ridgemoor Farm.

No other exposures were noted during the resurvey of the district, but in a brickyard formerly existing half a mile west of

---

* *Quart. Journ. Geol. Soc.* vol. vi., p. 253 (1850).

† Geology of Parts of Berkshire and Hampshire, 1862.

Ecchinswell Church, Prestwich saw the following section:—

Bluish-grey clay passing down into brown, sandy at base, a few calcareous concretions and fossils.

Basement Bed.—Ferruginous sand and iron-sandstone mixed with greensand and full of flint pebbles. No fossils except a few teeth of *Lamna.*

Reading Beds.—Mottled clay and sand.

Mr. Whitaker found fossils in the steep sides of a brook at the southern corner of Kingsclere Common, the beds consisting of blue clay, weathering brown and becoming sandy toward the upper part. The chief fossils were *Turritella imbricataria* Lam., *Natica labellata* Lam., *Corbula pisum* J. Sow., *Pectunculus brevirostris* J. de C. Sow., and *Ditrupa plana* J. Sow.*

3. BAGSHOT BEDS.

Following the nomenclature adopted by Mr. Whitaker in his Guide to the Geology of London,† this name is here employed to designate the beds which were formerly known as the Lower Bagshot Sands.

These beds succeed the London Clay and still cover rather more than half the area occupied by that clay within the limits of Sheet 283. In most parts of the London Basin the Bagshot Beds consist chiefly of white and yellow sands with some thin layers of pipeclay, but in this district they include some thickness of brown and reddish brown clay, partly sandy and partly laminated, This clay is comparable to the Ramsdell Clay of the adjoining areas to the north and north-west; in early days it was taken for part of the London Clay, which it much resembles, but subsequently it was found to be separated therefrom by some thickness of typical Bagshot sand.‡

There is a complete passage from the London Clay into these sands, but sometimes there is a thin layer of flint pebbles at the base of the latter. Owing to this passage the boundary line between the two formations is often rather obscure, but is frequently marked by the wetness of the ground and the growth of rushes near the junction owing to the water which constantly filters through the sands, and is thrown out by the underlying clay.

In the small tract of the Bagshot Beds which comes under description their total thickness is not more than 80 or 90 feet, and no fossils have been found in them.

Notes of Exposures.

A good section of the lower part of the Bagshot Beds is exposed at the Hollington Brickyard and has been measured by Mr. Osborne White, who also supplies the sketch from which Fig. 8 has been drawn.§

---

* Geology of the London Basin, 1872, p. 280.

† *Mem. Geol. Survey.* 5th Edition (1889), p. 55.

‡ See *Mems. Geol. Survey.* "Geology of Parts of Berkshire and Hampshire," by H. W. Bristow and W. Whitaker (1862), and "The Geology of the London Basin" (vol. iv., 1872), p. 311.

§ *Proc. Geol. Assoc.* Vol. xvii.. p. 394 (1902).

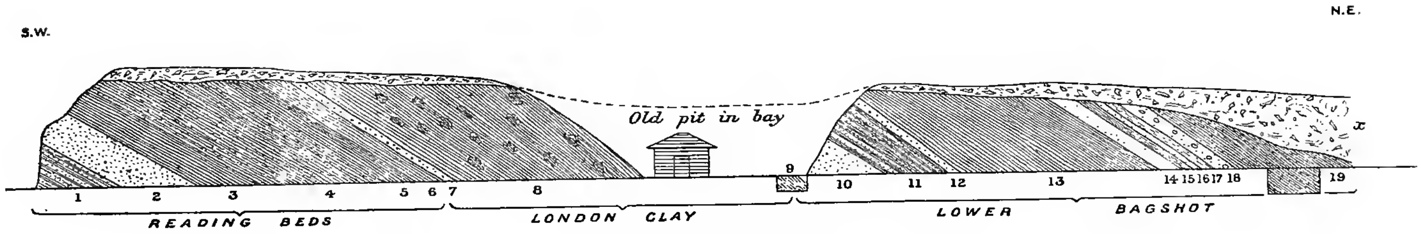


FIG. 8.—*Diagram of the beds seen in the Hollington Brickyard.* (H. J. O. WHITE.)

		Ft.	in.
Drift.	x White, angular flints, and flint pebbles in stiff, unstratified, mottled reddish-brown and greyish sandy clay	1–8	0
Bagshot Beds.	(19) Laminated, grey, iron-shot sandy clays	8	0
	(18) Yellow sand, with black markings, and hollow ironstone concretions	3	0
	(17) Grey, iron-stained, clayey sand	1	6
	(16) Yellow sand	0	6
Bagshot Beds.	(15) Grey, iron-stained, pipe-clay	0	10
	(14) Brown and yellow sand, with black markings	2	0
	(13) Obscurely laminated and banded, brown and greyish sandy clay (? Ramsdell Clay)	20	0
	(12) Layer of flint pebbles	0	2
	(11) Alternations of yellow sand and brown clay, with a pebbly layer near middle	8	0
	(10) Fine yellow sands - - - shown to depth of	5	0

For details of the London Clay and Reading Beds in this section see p. 40.

The Bagshot Beds here dip at about 30° to the north-east. It will be noticed that No. 13 is believed to represent the Ramsdell Clay, which is now classed with the Bagshot Beds. The junction of these beds with the London Clay was not seen when the section was visited in 1902, but may hereafter be exposed.

The following notes are furnished by Mr. F. J. Bennett.

At a cottage between the brickyard and Hollington there is a deep well of which the well-sinker gave the following account.

	Feet.
Mottled Clay -	about 16
Brown sandy clay	„ 40
Pipe clay - -	„ 5
Sandy clay (? sand) - -	„ 12
Dark bluish sandy clay with shells	„ 25
	98

The sandy clay at the bottom is probably London Clay.

At the Mount Kiln at the northern end of Highclere the pit showed the following beds dipping south at about 6°.

	Feet.
Drift Gravel (*see* p. 55) - - - -	2–5
Bracklesham—Stiff brown and lilac laminated clay - - -	7–10
Bagshot Sands—Yellow and white false-bedded sand, with patches of black matter (? oxide of manganese).	

A well near by was said to have been sunk through gravel and 4 feet of clay, and then through buff sand for 26 feet; a sandpit also close to the kiln exposed about 20 feet of reddish brown ferruginous false-bedded sand with seams of pipeclay.

The cutting on the railway east of Ridgemoor Farm shows the upper part of the Bagshot Beds overlain by the Bracklesham Beds (*see* p. 47).

The yellow sands (No. 1) here include some ferruginous bands due doubtless to the deposition of ferruginous matter by percolating water.

At Dodds Farm the well is said to have traversed the following beds:—brown clay, 3 feet; sand, 10 feet; dark clay, 7 feet into sand with water, total depth 22 feet, but the water was bad and sulphurous.

A small pit north of Earlstone Farm showed 3 feet of red sand. F. J. B.

The Bagshot Beds are also exposed in the Penwood or Tot Hill cutting north of Highclere Station where its thickness seemed to be less than in the southern outcrop. The beds exposed here in 1882 were thus recorded by Prof. T. R. Jones* in descending order.

	Feet.
Yellowish, brown and grey laminated sand -	16
Brownish-blue shale (bluish inside, brown outside)	4
Blue-black shale -	6
White clay -	2½
White sand (bottom not seen)	
	over 30

---

* *Geol. Mag.*, Dec. 3, vol. i., p. 123, 1882.

4. BRACKLESHAM BEDS.

Of these beds in the London Basin Prestwich remarked, "their thickness altogether does not exceed 40 to 60 feet; they nevertheless form a division, not only of distinct mineral character, but also of extremely persistent range and structure." He described them as consisting in the lower part of clays, with intercalated layers of beds of yellow sand, and in the upper part of greensands and sandy clays.*

The more recent observations of the Rev. Dr. A. Irving on these beds at the western end of the London Basin have confirmed Prestwich's general subdivision of the Bracklesham Beds into a lower band of clays and an upper band of greensands.† The usual succession in this district, according to Dr. Irving, is as follows:—

3. Sandy clay with green grains passing down into interlaminated greensands and clays.
2. Bright green sand.
1. Brown clays with a bed of coarse ferruginous sand.

These beds, and especially the greensands in the middle thin westward from Aldershot, and are not more than 40 to 45 feet thick near Highclere.

Dr. Irving has also shown that the green grains which give their colour to the sands are not glauconite nor any other green mineral, but are quartz-grains coated with a green or greenish-black material which he believes to be of vegetable origin and probably a combination of iron with humic acid.‡

Exposures.

The most complete exposure of these beds in our limited area was that furnished by the two cuttings on the Didcot and Winchester Railway, the one through Tot Hill, north of Highclere Station, the other to the south of that station. In the northern cutting the beds are dipping at about 3° to the south, while in the southern cutting their dip is 10° to the north, and the syncline thus indicated is shown in Fig. 9, which is reproduced from Dr. Irving's paper, by permission of the Council of the Geological Society.§

The following is taken from Dr. Irving's account: On my first visit, in company with Mr. Bennett, I detected the green earthy sands of the Middle Bagshot exposed in the cutting-slope for some distance at the northern end of the southern cutting.

---

* *Quart. Journ. Geol. Soc.*, vol. iii., p. 383, 1847.

† See *Quart. Journ. Geol. Soc.*, vol. xli., p. 494, 1885; vol. xliii., p. 374, 1887, and Geology of the country around Hungerford, *Mem. Geol. Survey.*

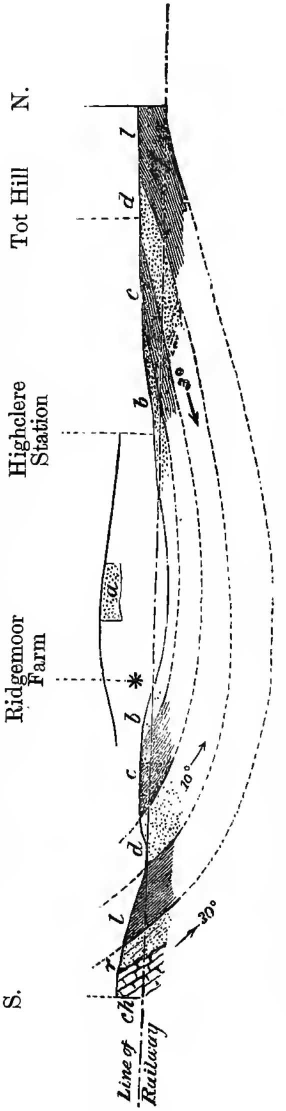
‡ See *Geol. Mag.*, Dec. 2, vol. x., p. 412, 1883.

§ *Quart. Journ. Geol. Soc.*, vol. xliv., 1888, p. 179.

These are succeeded southwards by the clayey series . . . . which are about 30 feet thick. These clays, with which towards the base considerable bands of ironstone are interbedded, are succeeded downwards by fine quartz-sand, which at lower horizons becomes somewhat loamy." This is the " Lower " Bagshot Sand.

FIG. 9.—*Section along the railway near Highclere.* (REV. A. IRVING.)

Scales : horizontal 2 inch = 1 mile. Vertical 1 inch = 200 feet.



a. Upper (" Bagshot ") Sands exposed in sand-pit ¼ mile west of section.
b. Green earths and sands } Bracklesham Beds (" Middle Bagshot ")
c. Lower clay-series with ironstone and irony sands }
d. Fine quartz-sand, more loamy below. (" Lower Bagshot.")
l. London Clay.
r. Reading Beds, with green-coated flints and *Ostrea bellovacina.*
ch. Chalk.

Mr. Bennett has recorded the succession of beds then visible in this cutting in greater detail, and made a sketch of them as seen on the western side of it, from which sketch the accompanying figure has been prepared :—

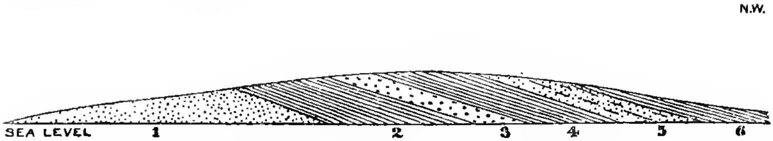


FIG. 10.—*Section in the railway-cutting south of Highclere Station.* Distance about a quarter of a mile.

(F. J. BENNETT.)

6. Greenish sandy clay.
5. Brown and grey clay with pockets of green sand.
4. Brown and red clay.
3. Coarse ferruginous sand.
2. Brown clay.
1. Orange and yellow sands (Lower Bagshot).

Of the Tot Hill cutting, Dr. Irving says: " Near the southern end of this cutting we recognised the green earthy sands of the Middle Group in a somewhat advanced stage of oxidation; and a bed which corresponds very well with the upper clayey bed (No. 5 of my tabulation) of the Middle Group is exposed in the bank at the station."

The succession referred to by Dr. Irving as probably existing here is as follows :—

4. Buff-coloured sand.
5. Drab-coloured sandy clay.
6. Sand with pebbles of black flint.
7 and 8. Green sand.
9 and 10. Clays, mostly coloured by Carbonaceous matter.

Mr. Bennett contributes the following notes on the same section: The railway-cutting north of Highclere Station shows sand with dark green grains, and in a letter to me in March, 1888, Mr. R. S. Herries stated that " on the western slope of the Penwood cutting, where there is a considerable slip of gravel, fossils occur in some small exposed patches of yellow sand, half way up the slope, and may have been thrown down from above in process of making the slopes. They are much better specimens than those from West Street sand-pit and seem to indicate a very low position in the Upper Bagshot or perhaps the top beds of the Middle. There are Volutes, *Turritella, Dentalium, Phorus, Cerithium ?, Pleurotoma ?, Bulla ?, Ostrea,* and perhaps *Pecten corneus.* The latter if a correct indentification, rather points to the beds being Middle."

" From the evidence afforded by the cutting and other indications a fair-sized outlier has been mapped extending into the Park. The other outliers formerly mapped are retained much as they were, and a small one at Pill Hill has been added where sand with green glauconitic grains was seen."

" An abandoned brickyard in Highclere village showed a bed of dark clay in the Bracklesham Beds. The thickness is about 30 feet."

5. UPPER SANDS.

These are the beds which were formerly known as the Upper Bagshot Sands, but as they have no connection with the true Bagshot Sands, it has been thought well to abandon the name of "Upper Bagshot" * and to group these sands with the Bracklesham Beds. Their exact age is still, however, a matter of doubt; by some they are compared with the Boscombe Sands in the Bracklesham series of the Hampshire Basin, and by others with the sands above the Barton Clay, but it should be noted that there is no Barton Clay, in the London Basin.

Only one small patch of these sands has been found within the area of Sheet 283, and this is at West Street, north-east of Whitway. Here is a sand pit of which Mr. Bennett writes. "It shows about 30 feet of yellow sand with small ferruginous concretions scattered here and there; the area covered by this sand is very small but there is a fairly distinct feature. Mr. R. S. Herries found here a few casts of fossils which resembled those which occur in the same sands elsewhere."

---

* *See* "Guide to the Geology of London," by W. Whitaker, *Mem. Geol. Survey*, 5th ed., 1889, p. 55.

CHAPTER VI.

CLAY-WITH-FLINTS.

Many patches and tracts of this deposit occur within the area of Sheet 283, and are of various sizes, from a small patch which cannot be shown on the one-inch map to a continuous tract of five miles in length. The disposition of these tracts is also somewhat remarkable; in the northern part of the area and also on the western border the deposit only occurs at high levels, and chiefly on ridges which slope southward from 900 to 600 feet, but in the central and southern parts it descends to lower levels and occurs as low as 300 feet and even below that level in places.

From the mapping of these tracts it seems clear that the Clay-with-flints, or the deposits from which it has been formed, once covered nearly the entire tract of Upper Chalk; further, that it was formed on a surface which in this district sloped chiefly southward but also in part eastward towards a line which is roughly parallel to the Valley of the Test, as if the material out of which it was made partook in the post-Eocene flexuring of the district.

Again, there are tracts of relatively high ground on which it might have been expected to occur, but on which hardly any trace of it has been found. Thus it appears to be absent on two of the hills south-east of Tidcombe, both of which rise to over 800 feet, although it occurs both to the west, south and north-east of these hills at elevations of from 700 to over 800 feet. Near Andover it does not occur on the highest ground east of the town, which rises to 400 feet, nor on the western slope of this ground, but only on its eastern slope toward the valley of the Test, and on this slope there are several patches occupying levels between 350 and 300 feet.

On the theory that the Clay-with-flints has been formed chiefly from the solution and disintegration of the Upper Chalk, its constituents being chalk-flints plus a certain amount of insoluble clayey matter, derived from the Chalk, it seems equally difficult to account for its occurrence in the one position and its absence in the other. For this and for other cogent reasons the writer is quite unable to accept that view of its origin.*

The only alternative view is that the argillaceous and sandy portions of the Clay-with-flints have been derived from the destruction and disintegration of the Eocene beds, and especially from the Lower Eocenes. On this view the seemingly capricious disposition of the deposit is capable of explanation, for we know that the Eocene beds once extended over the whole area, and that they partook to a large extent in the flexures into which the Chalk has been bent. We know, too, that these flexures were not simple and parallel curvatures, but a complicated series of scaphoid basins and domes. Hence I think we may assume that the tracts in which the Clay-with-flints descends to low levels are synclinal areas in which Eocene beds were formerly included.

---

* The origin of the Clay-with-flints has been discussed by me in a paper read before the Geological Society on January, 18, 1906, and published in Quart. Journ. Geol. Soc., vol. lxii., pp. 134-164.

At the same time we may freely admit that during the long time which has elapsed since the last submergence of the area much solution of the Chalk has taken place, and that here and there small patches of Clay-with-flints have been let down bodily to a lower level than they originally occupied, and that they have incorporated more flints during this process; but I do not think that the larger tracts have been lowered much, if at all, in this way.

In this connection it is worthy of notice that in spite of the southward slope of the surface on which the Clay-with-flints lies, the base of the deposit is nearer to the base of the Upper Chalk in the northern part of the area than it is in the south. Thus, on the high ground bordering the northern periclines the Clay-with-flints if correctly mapped, comes within 100 or 120 feet of the outcrop of the Chalk Rock, but when followed southward its border gradually rises on to higher parts of the Chalk till it is 200 feet or more above that horizon; while in the southern part of the area it rests on Chalk which must be about 400 feet above that rock.

It is true that what has been mapped as Clay-with-flints in this and adjacent areas is not a regular deposit of one uniform character, but includes not only typical Clay-with-flints, but also loams and brickearths and masses of nearly unaltered Eocene material, while in other places it is little more than a loamy soil enclosing angular and subangular flints. It may in fact be stated that where the Clay-with-flints caps a long ridge it generally passes at each end into such a loamy and flinty soil, which doubtless consists partly of flints left by solution of the underlying chalk and partly of a residium left from the detrition of the brickearth and true Clay-with-flints.

This, however, will not explain its position north of Ashmansworth, nor on Walbury Hill where it surrounds a small outlier of Eocene within 150 feet of the Chalk Rock. These facts seem to favour the view that the periclinal uplifts are partly of pre-Eocene date, and that their summits were planed off to some extent before the deposition of the Reading Beds. The Walbury outlier may have been let down by solution of the underlying chalk but hardly to the extent of 250 feet.

The accumulation which has been mapped as Clay with-flints in this part of Hampshire is mainly a stiff reddish-brown loamy clay, generally containing scattered angular flints, while near its base the flints are more numerous and are often as unworn and unbroken as when freshly derived from the Chalk. The whole deposit generally weathers into or is covered by a variable thickness of gravelly soil. When there is some thickness of the deposit the mass of it seldom contains many flints and is often so free from them that it has in several places been worked as brickearth. Mr. Bennett observes that it is sometimes so like the mottled clay of the Reading Beds that it can hardly be distinguished from it; in other places it shows black stains, and it sometimes includes beds of sand, lines of small flint pebbles and even occasionally a bed of gravel.

The thickness of the deposit varies very much and seems in some places to be as much as 30 or 40 feet while in others there is only 3 or 4 feet of it. Its base resting on the Chalk is always irregular, with deep pockets or hollows at intervals, and sometimes long cylindrical pits or pipes which descend for 40 to 50 feet into the Chalk and are filled with clay and flints. Mr. Bennett noted a good example of such pipes was visible in the railway cutting south-east of Hurstbourne Priors. He also observed that where the Clay-with-flints occurs on long gradual slopes, it assumes a very gravelly character, which may perhaps be due to the washing away of the clayey part by the rain, leaving the stones to form a kind of gravel. Examples of this may be seen in the gravelly slopes north and south-west of Hurstbourne Priors.

In considering the possible thickness of the Clay-with flints on the tops of the ridges it must be remembered that its boundary line along the sides of the ridge is nearly always much below the general level at which the material lies on the surface of the Chalk beneath the top of the ridge; the lateral portions of the deposit having been let down partly by solution of the underlying chalk and partly by the downward motion of the soil-cap during the excavation of the adjoining valleys. For instance, at Ashmansworth the top of the ridge at the Plough Inn is 768 feet above O.D., and the boundary of the Clay-with-flints on each side is mapped at coinciding with the contour-line of 700 feet, but it cannot be inferred that the thickness of the Clay at the Inn is 68 feet; probably it is not more than 10 or 12 feet, so that the clay does not really cap the ridge but only mantles its highest part, except where it happens to have subsided into hollows of unusually large size.

Local Notes.

The following notes are reprinted from the earlier Memoir by Messrs. Bristow and Whitaker (*see* p. 6):—

"At the north-east corner of Doles Wood, by Stoke Hill Farm, there is a ferruginous loam dug inside the wood for making bricks. At the depth of about 20 feet a bed of clay 3 feet thick was pierced, under which there was a layer of flints resting on another bed of loam. The latter was bored into for 5 feet without any chalk being met with. It was stated by one of the workmen that borings had been made nearly throughout the whole extent of the wood, and that the loam did not extend more than 100 yards from the pit in any direction—chiefly toward the north-west."

Stoke Hill Farm lies to the south-west of Stoke, and the deposit above described must be part of the large tract of brickearth and clay-with-flints in the centre ot the area, but part of Doles Wood seems to have been cut down since the above note was written.

"In Harewood Forest there are three outliers where bricks are made from the red mottled Plastic Clay which underlies the gravel and brickearth forming the upper part of the section;* but the thickness of the Eocene Beds is not more than a few feet, and it might almost be doubted if these lowermost beds are really a part of the latter series or merely drift (brickearth). Apparently, however, some of the lower clay seems to be mottled clay belonging to the true Woolwich and Reading Series; it contains rounded pebble-gravel, and has at the bottom large black-coated chalk-flints which are often found on the irregular surfaces of chalk at the base of the Tertiary formation in the Hampshire Basin."

---

* In 1862 these were regarded as outliers of Reading Beds, but are now included under the head of brickearth.

"The nature of these beds will be understood from the annexed figure (Fig. 11), sketched from one of the openings made in the small outlier at the south-west corner of Harewood Forest, between Goodworth Clatford and Mount Pleasant."

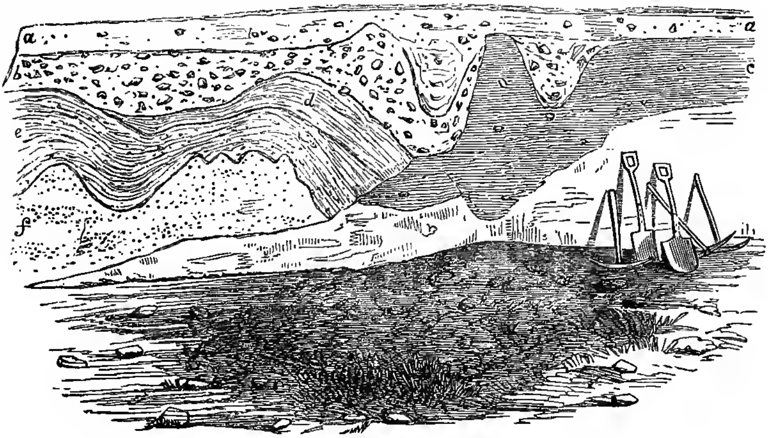


Fig. 11.—*View of clay pit in Harewood Forest.*

a. Loamy top-soil with a few small rounded and angular flints.
b. Mixture of rounded and small angular flint-gravel, in a reddish-brown clayey base.
c. Reddish-brown mottled clay passing into white clay mottled with red, and with an occasional rounded pebble.
d. Reddish-brown mottled clay containing carbonaceous matter.
e. White, yellowish, reddish and brownish clay, very sandy and much blackened by carbonaceous matter [or manganese].
f. Irony-yellow sand, red in places.

The following observations, quoted from the same Memoir, p. 45. refers to the north-western end of the same tract:—

There is a small outlier of brickearth on the spot marked "Tangley Clumps" in the map, where red mottled sandy clay and ferruginous brown clay were formerly made into bricks. The site of the pits is now (1862), however, overgrown with grass and bushes so that the actual section is concealed from view. Apparently this deposit was much washed, and from the occurrence of angular flints interspersed throughout the mass, as well as of angular fragments of chalk, it was considered more reasonable to associate these beds with the Drift rather than the Eocene. The depth of the clay here is about 40 feet."

"There are also traces of old brick-pits in Hurstbourne Park [West of Whitchurch], which have since been filled in. The clays, which are based on chalk, appear to have been mixed with flints and, like those of Tangley Clumps, to belong to the age of the superficial gravel."

The following notes, made in 1896, are furnished by Mr. F. J. Bennett:—

Most of Collingbourne Wood is occupied by clay-with-flints. North-west of Chute Lodge clay used to be dug for brickmaking and the pit was 30 feet deep.

Near Whistler Farm, one mile north-east of Tangley Church, a small brick yard showed stiff brown clay with a few flints, and at 7 feet down a tongue of coarse gravel, below which was stiff brown clay with black specks. I was told they had been down 25 feet in one place and 40 feet in another without reaching the bottom of the clay. It is difficult to account for the included tongue of coarse gravel with the clay at so high an elevation as 700 feet, as this seems to indicate water action.

Another kiln was once worked near Boxhill Farm nearly one mile to the north-west.

Both these sections occur at the head of a side valley leading down to the Bourne Valley.

Near Southington, at Brickkiln Farm, on the south side of the valley of the Test, clay was formerly dug for brickmaking, and the section showed 20 feet of interbedded gravel and loam, dipping sharply towards the valley, but 100 feet above the river. The deposit has been mapped as gravel overlying clay-with-flints, but it may in reality be part of the latter.

At Berrydown Farm, 1 mile east of the last place and close to the edge of the sheet, is another deep deposit of clay. I was told that the well at the brickyard here passed through 40 feet of clay before reaching chalk, but at the brickyard north of the farm 12 feet only of this clay was seen in the pit; the upper part was a stiff brown loam with a layer of small flints and pebbles at the base resting on brown clay with nests or aggregations of large and little worn flints.

In the tract of woodland known as Harewood Forest clay has been dug from time to time in several places, and one pit at the north of the Forest and south of Harewood Peak showed 15 feet of brown clay, stony at top. In the south-west corner of the map 2½ miles west-south-west of Kimpton a new road cutting has been made down Snoddington Hill through chalk with a few flints; and this is traversed by two deep pipes filled with materials which are probably of the age of the clay-with-flints. The height of the surface here is about 480 feet, and the depth of the cutting where deepest is about 15 feet. The eastern pipe or trough is wide at the top and narrows to about 3 feet at the road level; the filling material is chiefly of finely bedded-buff coloured sand, but the central part is filled with loose chalk blocks, and lower down with a rubble of chalk and flints. The western pipe runs obliquely, is 3 or 4 feet wide, and is filled with laminated buff-coloured loam, containing small bits of chalk arranged along the laminæ. The fine bedding of the material in both pipes is remarkable.

F. J. B.

CHAPTER VII.

SUPERFICIAL GRAVELS AND ALLUVIUM.

PLATEAU GRAVEL.

This gravel is only found near the northern border of the area, and is almost confined to the tracts occupied by the Bagshot and Bracklesham Beds, though in places it passes southward on to the top of the London Clay, but always keeps to a high level (over 400 feet).

The patches of Plateau gravel which come within the area of Sheet 283 are parts of a deposit which had a wide extension westward, northward and eastward. The questions of its age and origin cannot be discussed here, and for further information respecting it the reader is referred to Mr. Whitaker's "Guide to the Geology of London," and to the explanation of Sheet 267 (Hungerford), which describes the area immediately north of our district.

The material consists chiefly of flints, many being large, and often subangular, but some are rolled and waterworn; there are also many small flint pebbles and still smaller quartz-pebbles which are mostly less than half an inch long; a few fragments of ironstone occur, and blocks of sarsenstone are not infrequent.

The gravel as a rule is not stratified, and the components are often distributed in a patchy manner with regard to size, parts of the deposit consisting of large stones, and parts of small-sized material, but occasionally there are layers of brown sand which impart an appearance of stratification to the mass. The gravel usually contains much argillaceous matter, and the matrix in which the stones are embedded is frequently a mixture of clay and sand. In places, moreover, the gravel is overlain by 2 or 3 feet of reddish stony clay.

The following notes on small exposures within the area of Sheet 283 are by Mr. Bennett:—

At Pen Wood, a pit showed about 8 feet of this gravel, the upper part having a very clayey matrix, while that of the lower part was sandy and the materials of smaller size than in the upper.

At the Mount Brick Kiln, Woodhay, there is about 5 feet of clayey gravel, lying irregularly on the clays below and in places much intermixed with them.

Gravel with a clayey matrix is also seen in the railway cutting north of Highclere station.

A remnant of this gravel can be seen in the Hollington brickyard (*see* Fig. 8, p. 44), where it is described by Mr. Osborne White as consisting of white angular flints and some pebbles in reddish brown clay, unstratified, but thickening from 1 to a depth of 8 feet at the north-east end.

VALLEY GRAVEL.

Gravelly and sandy detritus brought down by rain exists in the lower parts of most of the valleys in the district, and these rain-wash gravels merge into the banks of gravel which occur more or less continuously along the longer valleys which are occupied by permanent streams.

On these gravels Mr. Bennett has the following note—they are composed almost entirely of flints, some of them hardly worn as if fresh from the waste of the Chalk or of the Clay-with-flints, others are broken into angular or subangular fragments and a few are waterworn. Sometimes the gravel is sharp and shingly without admixture of sand or loam, but in places it is sandy, and sometimes the stones are embedded in a chalk-sand or chalky paste. Occasionally, too, there are beds of loam or brickearth, as near Whitchurch.

The Collingbourne valley has a continuous floor of gravel from north of Aughton to and beyond North Tidworth. Near the North Tidworth Schools Mr. Bennett found a pit which showed ten feet of course, little-worn, flint-gravel and fine chalk-débris.

The following notes are also by Mr. Bennett:—

In the upper valley of the Anton, a little north of Redenham, a pit showed 4 feet of course subangular gravel with large unworn flints and some sarsen stones. At Weyhill Bottom, close to the schools, is a large pit with clean coarse and fine gravel little worn near the bottom; some large sarsen stones rest in a chalky matrix full of flints; at one part an irregular seam of greenish loam shows indications of stratification, but the gravel appears to have been the result of rapid accumulation and powerful water action. The total thickness was 25 feet. I was told that when the springs are high, the pit has water in it.

The largest spreads of gravel are in the valley of the Test, but those which adjoin the Clay-with-flints of Harewood Forest and near Hurstbourne Priors are probably partially destroyed tracts of that deposit and not truly valley gravels.

At Whitchurch, at the kiln north of the gas works, 12 feet of very coarse gravel and loam rest on the chalk on the slope of the hill at the bottom of the gravel I was told bones had been found, possibly elephant bones, also shells. The gravel contains masses of tabular and nodular flints, and rests on brown loam, and this on a whitish clay; both gravel and loam seem banked up against the chalk-slope.

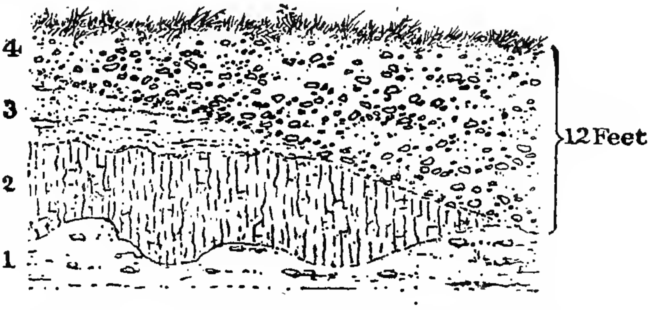


Fig. 12.—*View in Gravel Pit at Whitchurch.*

4. Coarse gravel.
3. Brown loam.
2. Whitish clay.
1. Chalk with an irregular surface.

There seems to be a higher terrace of gravel at Hurstbourne Park, but it has not been possible to separate it. The two cuttings south of Whitchurch show deep pipes of gravel in the chalk.

There is a good spread of gravel at Longparish and south of it. The gravel is mostly composed of coarse flints with some pebbles, and does not show much sign of stratification, and seems to be derived from the Clay-with-flints.

ALLUVIUM.

Their are no broad alluvial levels in the district under description, for it lies near one of the main watersheds of Southern England, and the valleys are consequently of small width, but narrow tracts of alluvium occur in several of them.

In the valley of the western Bourne a narrow strip of alluvium runs from Collingbourne Ducis southwards for about two miles, ending to the north of North Tidworth.

In the valley of the Anton and of its tributary the Pillhill brook there are continuous strips of alluvium.

In the Valley of the Test there is a small alluvial flat about a mile in length by Southington near Overton. The continuous alluvial level in this valley begins near Whitchurch and widens out to the south-west. Where the Bourne tributary joins the main stream there is an alluvial plain of about half a mile in width, but it narrows again beyond.

In the eastern Bourne valley there is also a strip of alluvium which commences by St. Mary Bourne Church.

CHAPTER VIII.

MISCELLANEOUS.

SPRINGS, BOURNES, AND SOILS.

Springs.—The area included within the limits of Sheet 283 being mainly one of Chalk Uplands, is essentially a dry district, and is not a land of springs; those which do exist being mostly of the temporary and intermittent type, which gives rise to a "bourne," *i.e.*, a stream that comes into existence only in the winter, or after a more than usually heavy rainfall.

It must not be supposed, however, that, because there are few permanent springs, the country is destitute of a permanent water supply. The Chalk is a great storehouse of water, being capable of absorbing a large quantity, so that every chalk-hill contains its store of water, which is only slowly lowered by the drought of a dry summer. Water is thus obtainable in all the valleys and combes by the simple process of sinking a well, and in such positions the wells are generally of small depth.

There are, moreover, two tracts within our area which may be described as well watered, since they contain several strong and permanently flowing springs; these are the eastern end of the Vale of Pewsey, in the north-west corner, and the Vale of Kingsclere in the north-east.

On the Upper Greensand, by the Graftons and near Marten, water is always near the surface and springs rise in the fields between West and East Grafton, and at two places between East Grafton and Marten. At Wilton there is also a spring head which appears to issue at or near the junction of the Greensand and Chalk.

Along the southern border of the Burghclere inlier there do not appear to be any springs. The Upper Greensand which here emerges from beneath the Lower Chalk is dry and the wells are deep, that at Burghclere Rectory being 114 feet and that at Sydmonton Court being 104 feet in depth. Towards the northern border, however, there are several springs issuing from the Greensand; Sydmonton Fish-ponds are doubtless supplied by springs at or near their southern end, and there is another to the north of them. The water flows to Ecchinswell, where there are also springs from the Chalk.

Another spring issues from the Greensand a quarter of a mile east of Nuthanger Farm, and the water flows northward across the Chalk and Eocene tracts. South of Kingsclere there are strong springs at a place known as the Well Head, situate on the Greensand about 380 yards south of Gaily Mill. These furnish a copious supply of water which is the motive power of four mills at Kingsclere. There is also a smaller spring near Gaily Mill, and one in the town at the junction of Chalk and Reading Beds.

Bournes.—The following notes are by Mr. Bennett:—

Bournes and intermittent streams are well represented in the area.

In the west we have the Bourne River rising two Miles north of Collingbourne Kingston at Southgrove Copse and Grafton Fields, in the Lower Chalk. The spot where the rise usually takes place is in a part of the wood within the next sheet to the west. The water takes from three days to three weeks to run down from Southgrove Copse to Collingbourne, and usually sinks between Collingbourne Ducis and North Tidworth. Some of the wells in Colingbourne Ducis, close to stream, overflow for some weeks during most winters; their depth is about 37 feet, and they are sometimes dry in the summer. They are in the Upper Chalk, but Chalk Rock seems to have been touched at the bottom.

The next bournes are found along the other Bourne River valley from Vernham Dean to Hurstborne Tarrant. A well at Vernham Dean 102 feet deep overflowed in 1857, and at that time Emholt Bottom was full of water.

The usual place for the water to rise is at the Bourne Hole known as the Hen Pit north of Hen Barn, west of Upton. On very rare occasions—about twice since 1857—Mr. J. Gilmour of Hurstbourne has known the water to rise as far up as Vernham Schools. About two miles east of the Hen Pit is another Bourne Hole called the Cock Pit in the Branch of the valley running north of Hurstbourne Tarrant; these pits fill simultaneously and are very nearly on the same level, viz., about 380 feet O.D. The water has been known to rise a mile higher up as far as Netherton.

Very occasionally the Cock and Hen are said to meet, *i.e.*, the water forms a continuous stream from these pits and meets at Hurstbourne Tarrant; it did so in 1876 and in 1883.

But in 1885 there was no water in the stream at Hurstbourne and the people were put to great straits. These details are from J. Stevens' "Parochial History of St. Mary Bourne."

At Seven Barrows, north Litchfield, a Bourne breaks out sometimes near the largest barrow about half a mile further south, close to the road; it rises every three or four years and sinks east of Clap Gate Cottages, close to the road. Bournes also rise at Upper Henley and Woolding Farm, forming a stream that joins the Test at the Workhouse. In 1890 the water rose at Upper Henley and it took two weeks before there was a continuous stream to Woolding Farm. Bournes probably rise occasionally in the valley between Charlton and Appleshaw.
F. J. B.

Soils and Agriculture.—Over the great part of the area above described the soil is of a very light nature, and on many parts of the Chalk land it is so thin as to be of little agricultural value, though this downland grows a short sweet turf and is good for the breeding of sheep.

Only three of the formations enumerated on page 2 yield anything like a stiff soil; these are the Lower Chalk, the London Clay, and the Clay-with-flints. The Lower Chalk, which only comes to the surface around the Vales of Pewsey, Shalbourn and Kingsclere, forms a stiff marly soil, and is specially suitable for the growth of cereals. The London Clay forms a heavy clay-soil, but its outcrop is too narrow to make it of much importance in this area. The tracts of Clay-with-flints are generally on high ground and they usually bear a surface layer of loose flints, so that they do not lend themselves to cultivation; but they support good timber, and much of the land on the lower slopes around them has received a wash of soil from above which has given a deeper staple to the chalk soil of such tracts.

The Upper Greensand forms a good soil, for in former days it supported a dense vegetation which has formed a dark vegetable mould of varying depth, and as the sand itself is loose and is not deficient either in lime or iron it is easily worked, and is capable of growing good crops of almost any kind of agricultural produce. It is also suitable for the growing of fruit, especially cherries and plums which require iron and this they can get from the glauconite in the sand.

APPENDIX.

WELLS AND BORINGS.

		Feet.
ASHMANSWORTH.—Lower Manor Farm, 650 O.D.. 12 feet water :*		
Soft Chalk. (Upper and Middle) No flints		360
BUTTERMERE.—At village. No particulars, 840 O.D. :*		
Chalk (Upper and Middle)		345
BURGHCLERE.—Manor House, 415 O.D. :*		
Sand and Rock (Upper Greensand)		130
Normans Court Farm, 411 O.D. Water not good :*		
Dark Clay (Lower Bagshot)		45
Post Office, 480 O D. Good Water :*		
Gravel	20	40
Sand (Bracklesham Beds)	20	
Near the School, 443 O.D. :*		
Gravel	15	22
Sand (Lower Bagshot Beds)	7	
Palmers Court Farm, 380 O.D. Water not good :*		
Loamy sand (Lower Bagshot Beds)		20
Near last on the Common, 430 O.D. :*		
Gravel	20	30
Sand (Lower Bagshot Beds)	10	
Down Farm, 450 O.D., 1½ miles S. of Old Church. 4 to 10 feet water :*		
(Middle) Chalk. No flints*		100
Ox Drove Lane, 450 O.D., House at :*		
Gravel	10	40
Sand (Bracklesham Beds)	30	
CHUTE.—Dean Farm, 562 O.D. No particulars given :*		
Chalk (Upper and Middle)		258
COMBE.—Village Well. No particulars given :*		
Chalk (Middle and Lower)		201
DUNLEY.—At cottages, 400 O.D. :*		
Chalk and few flints (Upper and Middle)		129
Manor House. 12 feet of water :*		
Chalk (Upper and Middle), with hard bed and Chalk Rock at 12 feet*		210
FACCOMBE.—At village. No particulars given, 750 O.D. :*		
Chalk (Upper and Middle)		314
FOSBURY.—At village. 20 feet of water :*		
Soft Chalk (Upper and Middle) with few flints		210
HIGHCLERE.—Tot Hill Farm, 430 O.D. :*		
Gravel		15
Another close by :*		
Gravel	10	25
Sand (Bracklesham Beds)	15	
Ball's Cottages, 420 O.D. :*		
Sand (Bracklesham Beds)		30
Keeper's House, Highclere Park, 450 O.D. :*		
Sand (Bracklesham Beds)		50
Treasurer's Hill, Pound Street, 458 O.D. :*		
Gravel	5	30
Sand (Bracklesham Beds)	25	
Pound Street at Cross Roads, 397 O.D. :*		
Gravel		
Clayey Boggy Soil (Lower Bagshot Beds)		20
Bottle Row, 401 OD. :*		
Blue Clay (Lower Bagshot Beds)		45
At House one quarter of a mile N. of Highclere Church*		
Sand (Lower Bagshot Beds)		45
Headstock Lodge, Highclere Park, 380 O.D. :*		
Blue Clay (Lower Bagshot Beds)		45
Highclere Farm, 432 O.D. :*		
Brown and Red Clay (Lower Bagshot Beds)		15

---

* Sunk and communicated by Mr. Broadhurst, Penn Wood Farm.

		Feet.
Between Maple House and Highclere St. Farm, 482 O.D. :*		
Gravel	10	130
Blue Clay (Lower Bagshot Beds)	20	
Black Clay and Shells (Lower Bagshot and London Clay)	100	
Church Lane Lodge :		
Chalk-with-flints		130
Dods Farm. Water rose to the surface, 370 O.D. :		
Brown Clay (Lower Bagshot Beds)	3	20
Sand (Lower Bagshot Beds)	10	
Dark Clay to Sand (Lower Bagshot Beds)	7	
Near Carpenters' Arms. Good water, 476 O.D. :*		
Loamy Sand (Bracklesham Beds)		45
Cottage half way between Tot Hill Bridge and the Station :*		
Gravel	10	45
Sand (Bracklesham Beds)	35	
Opposite Caernarvon Arms. Water rose 15 feet, 550 O.D. :*		
Red Clay (Lower Bagshot Beds)	10	100
Sand (Lower Bagshot Beds)	90	
London Lodge, Highclere Park, 506 O.D. :*		
Sand (Bracklesham Beds)		100
West Street. ?430 O.D. :*		
Sand (Bracklesham Beds)		30
West Street Farm. ?450 O.D. :*		
Sand (Bracklesham Beds)		350
Ridgemoor Farm ? 450 O.D. :*		
Sand (Lower Bagshot Beds)		30
Spring Lane*		
Blue Clay (Lower Bagshot Beds)		40
Another close by, near Wellhouse Farm. Water not good, 376 :*		
Black Clay (Lower Bagshot Beds)	-	30
Sand	.	
Hockley Hole.—Cottages at Duncroft Farm, 373·6 O.D. :†		
Blue Clay (London Clay)		40
Farm one-eighth of a mile north-west of Duncroft Farm. Water rose to surface when the rock was pierced :†		
Clayey sand to rock (Lower Bagshot Beds)		30
Linkenholt.—At Manor Farm, 650 O.D., 20 feet of water. No particulars given :†		
Chalk (Upper and Middle)		291
At Littledown, 650 O.D., close to the Chapel. Often dry :†		
Chalk with few flints	120	(? all Upper Chalk) 252.6
Rock	1·6	
Soft Chalk	131	
Rock		
Soft Chalk		
Rock		
Netherton.—At village, 447 O.D. No particulars. Water rose 50 feet ? :†		
Chalk (Upper and Middle)		240
Tangley.—Foxhounds, P.H., 550 O.D. Water burst through at bottom :†		
Soft Chalk with few flints to rock (Upper Chalk)		240
Vernham Dean.—In village, 440 O.D. Water rises to near the top where the springs are, and have been known to overflow :†		
Soft Chalk with few flints (Middle Chalk)		120
Near George Inn. Sometimes runs and sometimes is dry †		
Soft Chalk with few flints (Middle Chalk)		20
New Inn, Woodside, 443 O.D. Water rises to 10 feet of the top when the Springs are high :†		
Soft Chalk with few flints (Middle Chalk)		138
Vernham Street.—In village, 550 O.D. No particulars :†		
Chalk (Upper)		210
Upton.—Cowdown Farm, 450 O.D. :†		
Soft Chalk with flints (Upper and Middle)		165

---

*Sunk and communicated by Mr. Broadhurst, Penn Wood Farm.
†Sunk and communicated by Charles Alderman, Littledown.

KINGSCLERE.—Park House, about half a mile south of, 1890. Information from Mr. C. Garrett, of Kingsclere.

Well about 63 feet deep, sunk for 15 or 20 feet through grey chalk, then for 25 or 30 feet through green sand and sandstone; the lower part contains beds of very hard grey stone which had to be broken by steel chisel and hammer. A supply of good water found below these beds and has never failed. It would seem that the beds traversed were a follows:—

	Feet.
Grey Chalk	about 20
Green sand and sandstone	,, 25
Sand with beds of very hard stone	,, 18
	63

As Park House stands on Selbornian sand, the well can hardly have been at the house, but was probably at the farm to the south of it. An account of a boring on this Field Barn Farm has been communicated by Mr. G. W. Ockenden. of Kingsclere, as follows:—

		Feet.
Lower Chalk	Well dug in chalk	37
	Hard chalk (bored)	5
	Soft chalk mixed with clay	25
Selbornian	Rock-beds (glauconitic marl) Darker Sandy clay	26
		93

The following is also communicated by Mr. Ockenden:—

STANTON'S FARM.—Three-quarters of a mile north-west of Kingsclere—

		Feet.
Well dug (? in London Clay)		34
Reading Beds.	Mixed sand	25
	Bright yellow sand	5
	Darker sand	4
		68

INDEX.

A.

Agriculture, 59.
Alluvium, 57.
Ammonite Zones, 13.
Amport, 29, 33.
Andover, 1, 5, 22, 29, 33, 35, 50.
Anticlines, 3–7, 20, 33.
Anton, River, 2.
———, Valley, 56, 57.
Appleshaw, 33, 35, 59.
Area, 1.
Ashe, 2.
Ashmansworth, 18, 51, 52, 61.
Aughton, 15, 56.
Aveline, W. T., 11.
Avon, River, 2, 6.

B.

Bagshot Beds, 39, 43.
Barrois, Prof. C., 7, 8, 29, 31–33, 35.
Barton Clay, 39, 49.
Basement Bed of London Clay, 42, 43.
Beacon Hill, 2, 20.
Bee House Pit, 32, 35.
Belemnite Marl, 13.
Bennett, F. J., 11, 14–16, 20, 21, 24, 25, 41, 42, 45–48, 52, 53, 55, 56, 59.
Bere Hill, 35.
Berrydown Farm, 54.
Borings, 61.
Boscombe Sands, 39, 49.
Bourne, River, 2, 7, 59.
——— Valley, 23, 54, 57, 59.
Bournes, 58, 59.
Boxhill Farm, 54.
Bracklesham Beds, 39, 46.
Brickearths, 51–54.
Bristow, H. W., 6. 40, 42, 52.
Broadhurst, Mr., 9, 61.
Brydone, R. M., 8, 17, 30, 32–35.
Buckland, Prof., 6.
Burbage, 6.
Burghclere, 2, 5, 9, 11, 12, 16, 18, 20, 22, 23, 25, 27, 30, 34, 41, 42, 58, 61.
———— Manor House, 9.
———— Rectory, 58.
Bury Hill, Clatford, 35.
Buttermere, 1, 61.

C.

Cenomanian, 13.
Chalk, Divisions of the, 13.
———, Lower, 13, 59.
——— Marl, 13.
———, Middle, 13, 17.
——— Rock, 13, 19, 22, 24, 26.
———, Upper, 22.
———, Water in, 58.
Charlton, 59.
Chatwin, C. P., 22.
Chert-beds, 9–11.
Chloritic Marl, 13, 14.
Cholderton Hill, 2.
Chute, 61.
Clatford, 35.
———— Down, 23.
Clay-ironstone, 40.
———-with-flints, 50, 59.
Cold Henley, 31.
Collingbourne, 16, 59.
————— Ducis, 24, 29, 57, 59.
————— Kingston, 14, 15, 18, 20, 59.
————— Valley 56.
————— Wood, 1, 53.
Combe, 1, 18, 41, 61.
Cowhouse Farm, 31, 32, 34.
Cretaceous Rocks, 2, 9.
Cross Keys Pit, 32.

D.

Didcot and Winchester Railway, 7, 34, 41, 46.
Dodds Farm, 45.
Dods Down Brick Co., 15, 19, 24.
Doggers, 10.
Doles Wood, 1, 52.
Downs, 2, 59.
Drainage-system, Development of the, 6.
Dunley, 61.

E.

Earlstone Farm, 45.
Eastcott, 16.
East Woodhay, *see* Woodhay.
Ecchinswell, 11, 34, 39, 41–43, 58.
Emholt Bottom, 59.
Eocene, 2, 39.

Escarpments, 1, 6, 20.
Etheridge, R., 18.
Ewhurst, 7.

F.

Faccombe, 61.
Flexures, 3–7, 20, 33, 47, 51.
Flints with Sponges, 29, 32.
Formations included in Area 2.
Fosbury, 61.
Fossils from Lower Chalk, 17.
——— Middle Chalk, 19–21.
——— Selbornian, 12.
——— Upper Chalk, 28, 29, 36.
Foster, Sir C. le N., 6.

G.

Gault, 9.
Gauntlett, W. B., 15.
Gilmour, J., 59.
Glauconitic Chalk, 13, 23.
——— Sands, 9.
Grafton, 1, 10, 11, 14, 15, 58.
Grately, 33.
Gravel, Plateau, 55.
———, Valley, 55.
Green-coated Flints, 40.
——— Nodules, 22–26
Greensand, 9, 46.
Grey Chalk, 13.
Griffiths, C., 8, 31–33, 35.

H.

Harewood Forest, 1, 5, 35, 52–54, 56.
Henley, Upper, 59.
Hen Pit, 59.
Herries, R. S., 48, 49.
Highclere, 2, 5, 7, 22, 29, 39, 41, 42, 45–48, 55, 61.
Highclere Park, 29.
Hill, W., 16.
Hockley Hole, 62.
Hog-backs, 5.
Hogsback Ridge, 3.
Hollington, 40, 42–45, 55.
Hurstbourne Park, 53, 56.
——— Priors, 32, 33, 35, 52, 56.
——— Tarrant, 5, 18 59.

I.

Inkpen, 7, 40.
Ironstone, 40.
Irving, Rev. A., 7, 31, 46–48.
Itchenswell, 7, 11.

J.

Jones, Prof. T. R., 7, 45.

K.

Kimpton, 54.
Kingsclere, 1, 5, 6, 12, 14, 22, 23, 25, 27, 31, 42, 43, 58, 59, 63.
——— Gaily Mill, 59.
———, Vale of, 1–3, 5–7, 9, 12, 16, 18, 20, 24, 58, 59.
——— Well Head, 58.
Kingston Collingbourne, 5, 14.
Kintbury, 7.

L.

Larks Barrow, 31.
Linkenholt, 4, 62.
Litchfield, 5, 18, 24, 27, 31, 59.
Literature, 6.
Loams, 51–54, 56.
London Clay, 39, 40, 42, 59.
London and South Western Rly, 32.
Longparish, 56.
Lower Bagshot, 43.
——— Chalk, 13, 59.
——— Eocene, 39.
Ludgershall, 29.

M.

Malmstone, 9.
Manganese-ore, 45, 53.
Marten, 11, 58.
Marybourne Valley, 21, 57.
Melbourn Rock, 13, 15, 16, 18, 20.
Meyrick, E., 15.
Micheldever, 34.
Middle Bagshot, 46–48.
——— Chalk, 13.
Middleton, 32, 33.
Monxton, 29, 33.
Mount Kiln, Highclere, 45, 55.

N.

Neath End, 40.
Netherton, 59, 62.
Newbury Field Club, 7.
Newton, E. T., 16, 27.
Nodular Chalk, 18, 22–27.
Nuthanger Farm, 58.

O.

Ockenden, G. W., 63.
Odiham, 40.
Overton, 2, 32, 57.

P.

Pen Wood, 55.
Penwood Cutting, 45, 48.
Periclines, 3-5, 51.
Pewsey, Vale of, 1–3, 5, 6, 9, 11, 14, 18, 24, 58, 59.

Phosphatic Nodules, 13.
Physical Features, 1.
Pillhill Brook, 57.
Pipeclay, 43–45.
Pipes in Chalk, 52, 54.
Plastic Clay, 40.
Plateau Gravel, 2, 55.
Plocoscyphia, 20.
Prestwich, Sir J., 7, 41–43.

Q.

Quarley, 33.

R.

Railway-cuttings, 7, 10, 11, 19, 30–32, 34, 41, 46–48, 55.
Rain-wash Gravels, 52, 55.
Ramsdell Clay, 43–45.
Reading Beds, 39.
Redenham, 56.
Rhodes, J., 12, 16, 20, 25, 27, 31.
Ridgemoor Farm, 7, 42, 45, 47, 62.
Rivar, 4, 11.
River Valleys, 2, 5.
Rowe, Dr. A. W., 24, 25.

S.

St. Mary Bourne, 7, 26, 57.
Salisbury, 1.
——— Plain, 1.
Savernake, 11.
Selbornian, 2, 3, 9.
Senonian, 13.
Septaria, 42.
Seven Barrows, 59.
Shalbourn, 14.
———, Vale of, 1, 3, 14, 59.
Sharman, G., 16, 27.
Shaw Hill, 2.
Sidown Hill, 2.
Silex zones, 29.
Snoddington Hill, 54.
Soil cap Movements, 52.
Soils, 51, 59.
Southgrove Copse, 59.
Southington, 54, 57.
Sponge-bed, 26.
Sponges, 9, 14.
Spring-heads, 6.
Springs, 43, 58.
Stauronema carteri, 14.
Stevens, Dr. J., 7, 26, 35, 59.
Stockbridge, 33.
Stoke, 5, 7, 18, 21, 23, 26.
—— Hill, 27, 28, 52.
Strahan, Dr. A., 7.
Sunton, 24.
Superficial Deposits, 55.
Swale, 41.
Sydmonton, 2, 20, 21, 58.
Synclines, 3–5, 33, 47, 51.

T.

Tabular Flint, 24.
Tangley, 54, 62.
Tectonic Structure, 3.
Test, River, 2, 5, 7.
——, Valley, 29, 50, 54, 56, 57.
Tidcombe, 1, 2, 18, 24, 50.
Tidworth, 2, 33, 56, 59.
Titt, W. 14.
Topley, W., 6.
Tot Hill Cutting, 45–48.
Totternhoe Stone, 14, 16.
Treacher, Ll., 34, 35.
Turonian, 13.

U.

Uintacrinus Band, 30, 33, 34.
Upper Bagshot, 39, 47–49.
—— Chalk, 22.
—— Eocene, 39.
—— Greensand, 9, 58, 60.
Upton, 62.

V.

Vales, 1, 5, *see* also under Pewsey, etc.
Valley Gravel, 55.
Valleys, 2, 5.
——, Direction of, 2, 5, 6.
—— of Elevation.
Vernhams Dean, 18, 59, 62.

W.

Walbury Camp, 1, 16.
——— Hill, 5, 51.
Watersheds, 2, 5, 6.
Water-supply, 58.
Wells, 9, 15, 45, 58, 61.
—— and Borings, 61.
Westlake, E., 7, 26, 27, 32, 35.
West Street, 49.
Wexcombe, 1, 2, 4, 14, 15, 18, 20.
Weyhill Bottom, 56,
Whistler Farm, Tangley, 54.
Whitaker, W., 6, 13, 24, 41, 43, 45, 52.
Whitchurch, 5, 32, 56, 57.
———— Overton, 1.
White, H. J. Osborne, 6, 7, 15, 19–21, 24–27, 30–35, 40–43.
Whiting (Whitening) Pit, 32.
Whitway, 29, 34, 49.
Wilton, 15, 19, 24, 58.
Withers, T. H. 22.

Woodhay, East, 3, 4, 5, 7, 13, 14, 16, 18, 20, 40, 55.
Woolding Farm, 59.
Workhouse, 59.

Z.

Zone of *Actinocamax plenus*, 14.
——————— *quadratus*, 22, 33.
——— *Belemnitella mucronata*, 22
——— *Holaster planus*, 19, 22.
——————— *subglobosus*, 13, 14.
Zone of *Marsupites*, 22, 29, 31, 33.
——— *Micraster*, 19, 22.
——————— *coranguinum*, 22, 29.
——————— *cortestudinarium* 22.
——— *Pecten asper*, 9.
——— *Rhynchonella cuvieri* 18, 19.
——— *Schlœnbachia rostrata*, 9.
——————— *varians*, 13, 14.
——— *Terebratulina*, 18, 19.
——— *Uintacrinus*, 33.
Zones of the Chalk, 7, 13, 22.

GENERAL MEMOIRS.

SUMMARY OF PROGRESS of the GEOLOGICAL SURVEY for 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906 and 1907. Each 1s.

PLIOCENE DEPOSITS of BRITAIN. By C. Reid. 5s. 6d.

CRETACEOUS ROCKS OF BRITAIN.—Vol. I. GAULT AND UPPER GREENSAND OF ENGLAND. 9s. Vol. II LOWER AND MIDDLE CHALK. 10s. Vol. III. UPPER CHALK. 10s. By A. J. Jukes-Browne and W. Hill.

JURASSIC ROCKS OF BRITAIN.—Vol. I. YORKSHIRE, 8s. 6d. Vol. II. YORKSHIRE, Fossils, 12s. By C. Fox-Strangways. Vol. III. LIAS OF ENGLAND (Yorkshire excepted). 7s. 6d. By H. B. Woodward. Vol. IV. The Lower Oolitic Rocks of England. 10s. By H. B. Woodward. Vol. V. The Middle and Upper Oolitic Rocks of England. 7s. 6d. By H. B. Woodward.

BRITISH ORGANIC REMAINS. Decades I. to XIII., with 10 Plates each. Price 4s. 6d. each 4to ; 2s. 0d. each 8vo

MONOGRAPH I. On the Genus PTERYGOTUS. By T. H. Huxley and J. W. Salter. 7s.

MONOGRAPH II. On the Structure of the BELEMNITIDÆ. By T. H. Huxley. 2s. 6d.

MONOGRAPH III. CROCODILIAN REMAINS found in the ELGIN SANDSTONES. By T. H. Huxley. 14s. 6d.

MONOGRAPH IV. On the CHIMÆROID FISHES of the British Cretaceous Rocks. By E. T. Newton. 5s.

VERTEBRATA of the PLIOCENE DEPOSITS of BRITAIN. By E. T. Newton. 4s.

Museum Catalogues, &c. :—

HANDBOOK TO BRITISH MINERALS. By F. W. Rudler. 1s.

HANDBOOK to the MUSEUM of PRACTICAL GEOLOGY. 6d.

FOSSILS :—CAMBRIAN and SILURIAN, 2s. 6d. ; CRETACEOUS, 2s. 9d. ; TERTIARY and POST-TERTIARY, 1s. 8d.

DISTRICT MEMOIRS.

MEMOIRS of the GEOLOGICAL SURVEY OF GREAT BRITAIN. Vol. I. ESSAYS by De la Beche and Others. 21s. Vol. II. Part I., MALVERN HILLS. By J. Phillips. 21s. Part 2, ESSAYS, 21s. Vol. III. N. WALES. By Sir A. C. Ramsay. App., by J. W. Salter. and R. Etheridge. 2nd Ed. 21s.

CAMBRIDGE. By W. H. Penning and A. J. Jukes-Browne. 4s. 6d.

CORNWALL, DEVON, AND WEST SOMERSET. INDEX to De la Beche's Report on. By C. Reid. 1s.

DERBYSHIRE, NORTH. By A. H. Green, C. Le Neve Foster and J. R. Dakyns. 2nd Ed. By A. H. Green and A. Strahan. 5s. 6d.

FALMOUTH AND TRURO AND MINING DISTRICT OF CAMBORNE AND REDRUTH. By J. B. Hill and D. A. MacAlister. 7s. 6d.

FENLAND. By S. B. J. Skertchly. 36s. 6d.

HOLDERNESS. By C. Reid. 4s.

ISLE OF MAN. By G. W. Lamplugh. 12s.

TERTIARY FLUVIO-MARINE FORMATION of the ISLE OF WIGHT. By Edward Forbes. 5s.

ISLE OF WIGHT. By H. W. Bristow. New Ed. By C. Reid and A. Strahan. 8s. 6d.

ISLE OF PURBECK AND WEYMOUTH. By A. Strahan. 10s. 6d.

GUIDE TO GEOLOGICAL MODEL OF ISLE OF PURBECK. By A. Strahan. 6d.

LAKE DISTRICT, NORTHERN PART OF. By J. C. Ward. 9s.

LANCASHIRE, SUPERFICIAL DEPOSITS OF SOUTH WEST. By C. E. De Rance. 10s. 6d.

LONDON AND PART OF THE THAMES VALLEY. By W. Whitaker. Vol. I., 6s. Vol. II., 5s.

MIDLAND COUNTIES, TRIASSIC and PERMIAN ROCKS of the. By E. Hull. 5s.

NORFOLK and SUFFOLK, VERTEBRATA of the FOREST BED SERIES of. By E. T. Newton. 7s. 6d.

NORWICH. By H. B. Woodward. 7s.

RUTLAND, &c. By J. W. Judd. 12s. 6d.

Eruptive Rocks :—

ERUPTIVE ROCKS of BRENT TOR. By F. Rutley. 15s. 6d.

FELSITIC LAVAS of ENGLAND and WALES. By F. Rutley. 9d.

Iron Ores of Great Britain :— Part II. South Staffordshire. Price 1s. Part III. South Wales. Price 1s. 3d. Part IV. The Shropshire Coalfield and North Staffordshire. 1s. 3d.

Coal Fields :—

YORKSHIRE COALFIELD. By A. H. Green, R. Russell [and Others]. 42s.

EAST SOMERSET and BRISTOL COALFIELDS. By H. B. Woodward. 18s.

WARWICKSHIRE COALFIELD. By H. H. Howell. 1s. 6d.

LEICESTERSHIRE and SOUTH DERBYSHIRE COALFIELD. By C. Fox-Strangways. 6s.

NORTH STAFFORDSHIRE COALFIELDS. By W. Gibson [and Others]. 6s.

SOUTH WALES. (See under Sheet Memoirs, New Series.)

Sanitation and Water Supply :—

SOILS AND SUBSOILS from a SANITARY POINT of VIEW. By H. B. Woodward. 2nd Ed. 1s. 6d.

WATER SUPPLY OF SUSSEX. By W. Whitaker and C. Reid. 3s.

WATER SUPPLY OF BERKSHIRE, By J. H. Blake and W. Whitaker. 3s.

WATER SUPPLY OF LINCOLNSHIRE. By H. B. Woodward [and Others]. 4s. 6d.

WATER SUPPLY OF SUFFOLK. By W. Whitaker [and Others]. 3s. 6d.

WATER SUPPLY OF EAST RIDING OF YORKSHIRE. By C. Fox-Strangways, with contributions by H. R. Mill. 3s.

Gun Flint :—

MANUFACTURE OF GUN FLINTS. By S. B. J. Skertchly. 16s.

SHEET MEMOIRS OF OLD SERIES MAPS.

London Sheet. Guide to the GEOLOGY of LONDON and NEIGHBOURHOOD. By W. Whitaker. 6th Ed. 1s.
34 - - - PARTS of WILTS, and GLOUCESTERSHIRE. By A. C. Ramsay, W. T. Aveline and E. Hull. 8d.
44 - - - CHELTENHAM. By E. Hull. 2s. 6d.
45 - - - BANBURY, WOODSTOCK, and BUCKINGHAM. By A. H. Green. 2s.
45 SW - WOODSTOCK. By E. Hull. 1s.
47 - - N.W. ESSEX & N.E. HERTS. By W. Whitaker, W. H. Penning, W. H. Dalton, & F. J. Bennett. 2s. 6d.
48 SW - - COLCHESTER. By W. H. Dalton. 1s. 6d.
48 SE - EASTERN END of ESSEX (WALTON NAZE and HARWICH). By W. Whitaker. 9d.
48 NW, NE - IPSWICH, HADLEIGH, and FELIXSTOWE. By W. Whitaker, W. H. Dalton, & F. J. Bennett. 2s.
49 S, 50 SE - ALDBOROUGH, &c. By W. H. Dalton. Edited, with additions, by W. Whitaker. 1s.
49 N - - SOUTHWOLD. By W. Whitaker. 2s. 6d.
50 SW - - STOWMARKET. By W. Whitaker, F. J. Bennett, and J. H. Blake. 1s.
50 NW - - DISS, EYE, &c. By F. J. Bennett. 2s.
50 NE - - HALESWORTH and HARLESTON. By W. Whitaker and W. H. Dalton. 1s.
51 SE - - BURY ST. EDMUNDS and NEWMARKET. By F. J Bennett, J. H. Blake, and W. Whitaker. 1s.
51 NE - - PARTS of CAMBRIDGESHIRE and SUFFOLK. By W. Whitaker [and Others]. 2s.

SHEET MEMOIRS OF OLD SERIES MAPS—*continued.*

53 SE - PART of NORTHAMPTONSHIRE. By W. T. Aveline and Richard Trench. 8*d.*
53 NE - PARTS of NORTHAMPTONSHIRE and WARWICKSHIRE. By W. T. Aveline. 8*d.*
65 - S.W. NORFOLK and N. CAMBS. By W. Whitaker, S. B. J. Skertchly, and A. J. Jukes-Browne. 3*s.*
66 SW - ATTLEBOROUGH. By F. J. Bennett. 1*s.* 6*d.*
67 NW - E. DEREHAM. By J. H. Blake. 1*s.* 6*d.*
67 - YARMOUTH and LOWESTOFT. By J. H. Blake. 2*s.*
68 E - CROMER. By C. Reid. 6*s.*
68 NW,SW - FAKENHAM, WELLS, &c. By H. B. Woodward. 2*s.*
69 - BORDERS OF THE WASH. By W. Whitaker and A. J. Jukes-Browne. 3*s.*
70 - S.W. LINCOLNSHIRE, &c. By A. J. Jukes-Browne and W. H. Dalton. 4*s.*
71 NE - NOTTINGHAM. By W. T. Aveline. (2nd Ed.) 1*s.*
79 NW - RHYL, ABERGELE, and COLWYN. By A. Strahan. (Notes by R. H. Tiddeman.) 1*s.* 6*d.*
79 SE - FLINT, MOLD, and RUTHIN. By A. Strahan. (Parts by C. E. De Rance.) 4*s.* 6*d.*; *Supplement* 2*d.*
80 NW - PRESCOT, LANCASHIRE. By E. Hull. (3rd Ed. With additions by A. Strahan.) 3*s.*
80 SW - CHESTER. By A. Strahan. 2*s.*
81 NW,SW - STOCKPORT, MACCLESFIELD, CONGLETON, and LEEK. By E. Hull and A. H. Green. 4*s.*
82 SE - PARTS of NOTTINGHAMSHIRE and DERBYSHIRE. By W. T. Aveline. (2nd Ed.) 6*d.*
82 NE - PARTS of NOTTINGHAMSHIRE, YORKSHIRE, and DERBYSHIRE. (2nd Ed.) By W. T. Aveline. 1*s.*
83 - LINCOLN. By W. A. E. Ussher, A. J. Jukes-Browne, and A. Strahan. 3*s.*
84 - EAST LINCOLNSHIRE. By A. J. Jukes-Browne. 3*s.* 6*d.*
86 - N. LINCOLNSHIRE and S. YORKSHIRE. By W. A. E. Ussher [and Others]. 2*s.*
87 NW - WAKEFIELD and PONTEFRACT. By A. H. Green. 6*d.*
87 SW - BARNSLEY. By A. H. Green. 9*d.*
88 SW - OLDHAM. By E. Hull. 2*s.*
88 SE - PART of the YORKSHIRE COALFIELD. By A. H. Green, J. R. Dakyns, and J. C. Ward. 1*s.*
88 NE - DEWSBURY, &c. By A. H. Green, J. R. Dakyns, J. C. Ward, and R. Russell. 6*d.*
89 SE - BOLTON, LANCASHIRE. By E. Hull. 2*s.*
90 SE - COUNTRY between LIVERPOOL and SOUTHPORT. By C. E. De Rance. 3*d.*
90 NE - SOUTHPORT, LYTHAM, and SOUTH SHORE. By C. E. De Rance. 6*d.*
91 SW - COUNTRY between BLACKPOOL and FLEETWOOD. By C. E. De Rance. 6*d.*
91 NW - SOUTHERN PART of the FURNESS DISTRICT in N. LANCASHIRE. By W. T. Aveline. 6*d.*
92 SE - BRADFORD and SKIPTON. By J. R. Dakyns, C. Fox-Strangways, R. Russell, and W. H. Dalton. 6*d.*
93 NW - NORTH and EAST of HARROGATE. By C. Fox-Strangways. 6*d.*
93 NE - COUNTRY between YORK and MALTON. By C. Fox-Strangways. 1*s.* 6*d.*
93 NW - N. and E. of LEEDS and near TADCASTER. By W. T. Aveline, A. H. Green [and Others].
93 SE, 94 SW COUNTRY between YORK and HULL. By J. R. Dakyns, C. Fox-Strangways, and A. G. Cameron. 1*s.* 6*d.*
94 NW - DRIFFIELD. By J. R. Dakyns and C. Fox-Strangways. 9*d.*
94 NE - BRIDLINGTON BAY. By J. R. Dakyns and C. Fox-Strangways. 1*s.*
95 SW,SE - SCARBOROUGH and FLAMBOROUGH HEAD. By C. Fox-Strangways. (2nd Ed.) 4*s.* 6*d.*
95 NW - WHITBY and SCARBOROUGH. By C. Fox-Strangways and G. Barrow. 1*s.* 6*d.*
96 SE - NEW MALTON, PICKERING, and HELMSLEY. By C. Fox-Strangways. 1*s.*
96 NE - ESKDALE, ROSEDALE, &c. By C. Fox-Strangways, C. Reid, and G. Barrow. 1*s.* 6*d.*
96 NW,SW - NORTHALLERTON and THIRSK. By C. Fox-Strangways, A. G. Cameron, and G. Barrow. 1*s.* 6*d.*
97 SW - INGLEBOROUGH. By J. R. Dakyns, R. H. Tiddeman, W. Gunn, and A. Strahan. 2*s.*
97 NW - MALLERSTANG. By J. R. Dakyns, R. H. Tiddeman [and Others]. 3*s.* 6*d.*
98 NE - KENDAL. By W. T. Aveline and T. Mc K. Hughes. 2nd Ed. by A. Strahan. 2*s.*
102 SW - APPLEBY, ULLSWATER, &c. By J. R. Dakyns, R. H. Tiddeman, and J. G. Goodchild. 1*s.* 6*d.*
104 SW, SE - NORTH CLEVELAND. By G. Barrow. 1*s.* 6*d.*
107 - CARLISLE. By T. V. Holmes. 1*s.* 3*d.*
108 SE - OTTERBURN and ELSDON. By Hugh Miller. 2*s.* 6*d.*
108 NE - CHEVIOT HILLS. By C. T. Clough. 1*s.* 6*d.*
108 SW - PLASHETTS and KIELDER. By C. T. Clough. 1*s.*
110 SW - WOOLER and COLDSTREAM. By W. Gunn and C. T. Clough. 1*s.* 6*d.*
110 NW - NORHAM and TWEEDMOUTH. By W. Gunn. 6*d.*
110 NE - COAST SOUTH of BERWICK-ON-TWEED. By W. Gunn. 9*d.*
110 SE - BELFORD, HOLY ID, and FARNE ISLANDS. By W. Gunn. 2*s.* 6*d.*

SHEET MEMOIRS OF NEW SERIES MAPS.

110 - MACCLESFIELD, CONGLETON, &c. By T. I. Pocock [and Others]. 2*s.* 6*d.*
123 - STOKE-UPON-TRENT. By W. Gibson and C. B. Wedd. (2nd Ed.) Price 1*s.* 6*d.*
125 - DERBYSHIRE and NOTTINGHAMSHIRE COALFIELD, SOUTHERN END of. By W. Gibson [and Others]. 3*s.*
141 - DERBY, BURTON-ON-TRENT, &c. By C. Fox-Strangways. 2*s.*
155 - ATHERSTONE and CHARNWOOD FOREST. By C. Fox-Strangways. 2*s.*
156 - LEICESTER. By C. Fox-Strangways. 3*s.*
230 - AMMANFORD. By A. Strahan [and Others]. 2*s.* 6*d.*
231 - MERTHYR TYDFIL. By A. Strahan, W. Gibson, and T. C. Cantrill. 1*s.* 6*d.*
232 - ABERGAVENNY. By A. Strahan and W. Gibson. 2*s.*
246 - WEST GOWER. By A. Strahan. 8*d.*
247 - SWANSEA. By A. Strahan [and Others]. 2*s* 6*d.*
248 - PONTYPRIDD. By A. Strahan, R. H. Tiddeman, and W. Gibson. 1*s.* 6*d.*
249 - NEWPORT, MON. By A. Strahan. 2*s.*
262 - BRIDGEND. By A. Strahan and T. C. Cantrill. 1*s.* 6*d.*
263 - CARDIFF. By A. Strahan and T. C. Cantrill. 2*s.* 3*d.*
267 - HUNGERFORD and NEWBURY. By H. J. Osborne White. 2*s.* 6*d.*
268 - READING. By J. H. Blake and H. W. Monckton. 1*s.* 6*d.*
282 - DEVIZES. By A. J. Jukes-Browne. 1*s.*
295 - QUANTOCK HILLS, TAUNTON and BRIDGWATER. By W. A. E. Ussher. 2*s.*
298 - SALISBURY. By C. Reid [and Others]. 1*s.* 3*d.*
311 - WELLINGTON and CHARD. By W. A. E. Ussher. 1*s.* 3*d.*
314 - RINGWOOD. By C. Reid [and Others]. 1*s.*
315 - SOUTHAMPTON. By C. Reid. 1*s.* 6*d.*
317 - CHICHESTER. By C. Reid [and Others]. 1*s.*
325 - EXETER. By W. A. E. Ussher. 2*s.*
326 & 340 - SIDMOUTH and LYME REGIS. By H. B. Woodward and W. A. E. Ussher. 1*s.*
328 - DORCHESTER. By C. Reid. 1*s.*
329 - BOURNEMOUTH. By C. Reid. 4*d.*
332 - BOGNOR. By C. Reid. 6*d.*
334 - EASTBOURNE. By C. Reid. 6*d.*
346 - NEWQUAY. By C. Reid and J. B. Scrivenor. 3*s.*
348 - PLYMOUTH and LISKEARD. W. A. E. Ussher and J. S. Flett. 3*s.*
350 - TORQUAY. By W. A. E. Ussher. 2*s.*
351 & 358 - LAND'S END DISTRICT. By C. Reid and J. S. Flett.
352 - FALMOUTH and TRURO and MINING DISTRICT OF CAMBORNE and REDRUTH. By J. B. Hill and D. A. MacAlister. 7*s.* 6*d.*
353 - MEVAGISSEY. By C. Reid. 2*s.*
355 & 356 - KINGSBRIDGE and SALCOMBE. By W. A. E. Ussher. 1*s.* 6*d.*
357 & 360 ISLES OF SCILLY. By G. Barrow. 1*s.*
— - OXFORD. By T. I. Pocock [and Others]. 2*s.* 3*d.*